# REPORT RESUMES

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TECHNOLOGY AND MANPOWER IN THE HEALTH SERVICE INDUSTRY, 1965-75.
BY- STURM, HERMAN M.
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BASED UPON PUBLISHED SOURCES AND INTERVIEWS WITH EXPERTS, THE STUDY LOOKS TOWARD PROBABLE CHANGES IN THE SIZE AND JOB CONTENT OF KEY HEALTH OCCUPATIONS TO POINT OUT PROBLEMS AND OPPORTUNITIES IN DEVELOPING PROGRAMS AND POLICIES. SOME FACTORS AFFECTING HEALTH MANPOWER ARE (1) DEVELOPMENTS IN DIAGNOSIS AND PATIENT CARE, INCLUDING AUTOMATED CLINICAL LABORATORY EQUIPMENT, IMPROVED SURGICAL TECHNIQUES AND EQUIPMENT, AND THE USE OF THE ELECTRONIC COMPUTER IN DIAGNOSIS, (2) HOSPITAL INFORMATION HANDLING, ESPECIALLY THE APPLICATION OF THE ELECTRONIC COMPUTER, (3) IMPROVEMENT IN HOSPITAL SUPPLIES AND SERVICES, INCLUDING THE USE OF DISPOSABLE ITEMS AND IMPROVED MATERIALS HANDLING EQUIPMENT, AND (4) IMPROVEMENTS IN THE MANAGEMENT AND STRUCTURAL DESIGN OF HEALTH FACILITIES FOR BETTER UTILIZATION OF PERSONNEL, EQUIPMENT, AND SPACE. IN GENERAL, CHANGING TECHNOLOGY WILL AFFECT HEALTH MANPOWER GRADUALLY. LABORSAVING INNOVATIONS WILL PROBABLY NEITHER CAUSE WORKERS TO LOSE THEIR JOBS NOR ALLEVIATE HEALTH MANPOWER SHORTAGES. CONTENT OF HEALTH JOBS WILL CHANGE, AND NEW JOBS WILL APPEAR AS NEW EQUIPMENT AND TECHNIQUES ARE INTRODUCED, BUT THE DEMANDS FOR WORKERS WITH NEW SKILLS WILL PROBABLY NOT OUTSTRIP THE CAPACITY FOR TRAINING THEM UNDER WIDELY RECOMMENDED LONG-RANGE PLANS. ANTICIPATED EMPLOYMENT GROWTH FROM 1965 TO 1975 IS 75 PERCENT FOR X-RAY TECHNICIANS, 60 PERCENT FOR MEDICAL LABORATORY PERSONNEL, 55 PERCENT FOR REHABILITATION AND OTHER TECHNICIANS, AND MORE THAN 40 PERCENT FOR NURSING PERSONNEL. RECOMMENDED ARE THE REMOVAL OF WAGE AND EMPLOYMENT CONDITION INEQUITIES TO ATTRACT ALREADY QUALIFIED PERSONS BACK TO EMPLOYMENT, THE EXPANSION OF GOVERNMENT AND PRIVATE TRAINING PROGRAMS, AND BETTER COORDINATION BETWEEN GOVERNMENT AND PRIVATE AGENCIES IN DEALING WITH HEALTH MANPOWER SHORTAGES. THIS DOCUMENT IS AVAILABLE FROM U.S. DEPARTMENT OF LABOR, MANPOWER ADMINISTRATION, OFFICE OF MANPOWER POLICY, EVALUATION, AND RESEARCH, WASHINGTON, D.C. 20210. (JK)

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# Technology and Manpower In The HEALTH SERVICE INDUSTRY

## 1965–75

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U.S. DEPARTMENT OF LABOR: W. Willard Wirtz, Secretary
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*Office of Manpower Policy, Evaluation, and Research*
*Curtis C. Aller, Director*

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*Technology and Manpower In The*

# *HEALTH SERVICE INDUSTRY*

*1965–75*

*U.S. DEPARTMENT OF LABOR: W. Willard Wirtz, Secretary*
*MANPOWER ADMINISTRATION*

# *Preface*

Technological change has brought about vast changes in the social and economic structure of the United States. Of significant importance for more than a century, the influence of technology has been especially noticeable in the last two decades. Technological advances made during World War II established the foundation for many entirely new products and industries. More recently, Government military and space research expenditures, combined with greatly increased industrial spending for research and development, have produced an abundance of technological advancements which promise to have an even greater influence on our economy.

Technological change has important effects on the labor force. Existing occupations are eliminated, others decline in importance; totally new occupations come into existence, job content changes, and new skills are required. Although a wide variety of mechanisms are available to facilitate manpower adjustment to technological change, planning lies at the core of each. The U.S. Department of Labor has for many years recognized in its research programs the need for advanced information on the potential impact of technology.

Early in 1965, an experimental and demonstration project was launched within the Department of Labor as part of the Department's continuing efforts to refine and improve its research methods. The project was aimed at using interpretive analysis techniques, based on extensive industry interviews, to fill gaps in facts and judgments needed for planning manpower development efforts by industry, union, and school systems and for program and policy development within the Department of Labor. Three industries and functional areas in which technology is expected to have important manpower effects were selected and studied in depth. They are: The health service industry (covered in this report); the design/drafting process (see *Technology and Manpawer in Design and Drafting, 1965–75*); and the telephone communications industry (see *Technology and Manpower in the Telephone Industry, 1965–75*).

This report was prepared by Herman M. Sturm under the supervision of Peter E. Haase, project director, and under the general direction of Curtis C. Aller, director, Office of Manpower Policy, Evaluation, and Research.

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# Introduction

In recent years the demand for medical and other health services has been increasing rapidly. Consumer expenditures for medical, dental, and other health care and public budgets for community health programs and health research are at peak levels. Coverage of families and individuals under prepaid health insurance plans has become widespread. The establishment of the Medicare programs has added to demand. In many areas, demands for health care have outstripped the availability of physicians, nurses, and other trained health workers. Shortages of hospital nurses are especially critical. Lack of sufficient trained health personnel has become a matter of national concern, not only because of domestic needs but also because of increased obligations overseas for both military and civilian programs.

These trends have been developing against a background of stepped-up interest in opportunities for employment in the health service industry, especially for individuals who have had difficulty in getting work. Health service is one of the largest industries in the country. Well over 3½ million persons are active in health service and related fields. The number of jobs available is growing rapidly in many communities. Administrators of health facilities throughout the Nation are constantly looking for workers because of heavy labor turnover—as well as the growth in demand for health services.

Needs for health manpower have been expanding at a time when the number of new entrants to the labor force has also been rising. Thousands of young people are preparing for the health professions at schools and universities, and many others are learning and gaining experience in health work on the job or in special training courses. Health occupations are in the lead among courses given in new training programs sponsored by Federal and State Governments. They account for a large proportion of all projects and trainees in programs provided under the Manpower Development and Training Act and related legislation.

Many problems need to be considered in planning and developing programs to meet the need for manpower in the health service field. The field is made up of numerous groups and institutions that have a common goal—caring for sick people—but also some basic differences: In training and professional approach, in income patterns and wage structure, and in attitudes and goals. The needs for adjusting manpower programs to take these factors into account is complicated by the fact that methods of detecting illness and caring for patients are constantly changing.

Growing in significance are many recent technological developments affecting various phases of the health service industry. Some technological innovations offer promise of manpower savings which may help offset shortages of health personnel and reduce the steadily mounting costs of health care as well. Other innovations bring into being changes in job content and demands for training new kinds of specialists.

This report is particularly concerned with the relationship between technological advances and other developments that will affect manpower in the health service industry during the next decade. It utilizes both readily available information and expert judgments to develop projections of future employment in major health occupation groups. The main purpose is to look ahead toward probable changes in the size and job content of key health occupations, and to point out problems and opportunities that will have to be considered in developing health manpower programs and policies.

The main body of the report consists of three chapters. The first presents and analyzes trends in the structure and characteristics of health service employment and summarizes major current problems in meeting health manpower needs and job requirements. The second chapter identifies the technological developments likely to have impacts on manpower in the next 10 years and examines what their effects may be. The third analyzes the combined effect of expected trends in the demand for health services and of key technological developments on the structure of health service employment. This analysis is used as the basis for projections of growth in employment in the next 10 years and of structural changes that will probably affect health jobs in the future.

In view of the broad scope of the study, it was not possible to report in detail on all significant developments related to health manpower and technology, nor to provide a detailed, systematic analysis of each of the many specific problems involved in programs for developing health manpower. Many detailed studies are needed, especially to deal with specific problems of shortages in particular health occupations. This report does provide a general perspective and some conclusions which may be useful in shaping broad programs and policies.

The study is based to a substantial extent on published sources cited in the appendix. It has also relied heavily on interviews with experts in various fields who helped to provide judgment and perspective on current problems and the future outlook, as well as some estimates to fill gaps in available data. Interviews of substantial length were conducted with 51 individuals whose names and affiliations are listed in the appendix. Additional information was obtained from others not listed (including individuals present at group meetings, persons who answered questions by telephone or mail, and staff of various offices of the U.S. Department of Labor). Without the assistance of these individuals, it would not have been possible to achieve the purposes of this study.

# *Overview*

## *The Manpower Background*

Demand for health services has been increasing rapidly in recent years, and has outstripped the supply of available trained health manpower in many areas and occupations. Shortages among some skilled groups are becoming critical.

Costs of health care have been rising, reflecting both higher labor costs in hospitals and improved standards of health care. But wage levels and other conditions of employment in health occupations continue to be substantially lower than those of other pursuits; substantial numbers of health workers lack full protection of minimum wage requirements, social security, and other labor legislation. These inequities are among the factors that account for difficulties in filling health jobs.

Among health occupations, professional and practical nurses are in particularly short supply. These two occupations, plus nursing auxiliaries, account for roughly half of all health service jobs. Also scarce in many areas are clinical laboratory personnel, X-ray technologists, rehabilitative technicians and therapists, and pharmacists. (Physicians and dentists are not included among the manpower categories studied in this report.)

Public and private facilities are instructing students and trainees in various health occupations. The wide scope of training programs sponsored through Manpower Development and Training Act (MDTA) provisions has been particularly important in alleviating many health manpower shortages. Other important programs, provided by recent Federal legislation, are helping to solve the long-range problem of improving the quality of nursing and other professional personnel.

## *Technological Developments and Expectations*

Substantial advances have been made in medical research on disease prevention and cure, and in environmental health protection. Further scientific advancement, as well as expanded programs for combating environmental hazards, can clearly be expected. These successes will save many lives and protect the health of millions, but their net effect is not expected to alter greatly the kinds of health services needed in hospitals or other patient care facilities during the next decade.

The innovations in health technology that will most affect health manpower in the next 10 years are most certainly those now being designed or adopted for use in patient care facilities. They will involve various kinds of manpower changes, including changes in job content and emergence of new jobs, as well as some laborsavings.

Significant changes in technology affecting patient care facilities are of many different kinds. They may be grouped as follows: (*a*) Developments in diagnosis and patient care; (*b*) hospital information handling; (*c*) developments affecting hospital supply and services; (*d*) improvements in the management and structural design of health facilities.

Improvements in patient care technology include such specific developments as automated clinical laboratory equipment, artificial human organs, improved surgical techniques and equipment, and use of the electronic computer to help in diagnosis.

Advances in hospital information handling will come mainly from applications of the electronic computer. Computers are being used to handle patient billing and accounting, and in medical research and diagnostic applications. They are also being developed to control the flow of information in hospitals so that physicians can get ready access to necessary data, and have their orders for treatment of patients quickly and accurately transmitted to all affected departments. The computer can help nursing, technical, and other departments avoid errors and attain greater efficiency with less paperwork.

Improvements in hospital supplies and services include adoption of disposable items made of plastic and other inexpensive materials, such as hypodermic needles, surgeon's gloves and surgeon's knives, adoption of improved materials handling equipment, such as specialized carts, conveyors, and pneumatic tubes.

Advances in the functional and structural design of hospitals help toward more efficient utilization of personnel, equipment, and space. They involve continuing improvement in both management and construction of health facilities, putting into effect concepts of progressive patient care and other advances in organizing health services.

These different innovations are being adopted rapidly in some instances, more slowly in others. They vary both in regard to laborsaving effects and in affecting the nature of work done by health service personnel.

Automation in the laboratory is already well advanced, and will continue to affect both the volume of demand for medical laboratory workers and the content of their jobs. The switch to disposables is already widespread and clearly results in laborsaving. In general, other changes in patient care technology are proceeding more slowly; they will especially affect the job content of nurses and some categories of technicians. Use of the computer in hospital information handling, and improvements in the functional organization, management, and design of hospitals and other health facilities are likely to have significant effects on the numbers of workers needed mainly by improving productivity, but it will take time for the effects of these improvements to become widespread.

## *The Outlook for Health Manpower*

Anticipated trends in the volume of demand for patient care service and in the kinds of facilities and care needed are the primary influences on future demand for health manpower. Particularly important will be the Medicare program, which will accelerate needs for personnel to staff hospital nursing units, service, and outpatient departments and for new nursing homes and home care programs. The expanding demand for laboratory tests and X-rays will result in continued increases in the need for people trained to do these jobs. Technological developments will affect the amount of manpower needed by the various health occupations differently. (See chart 1.)

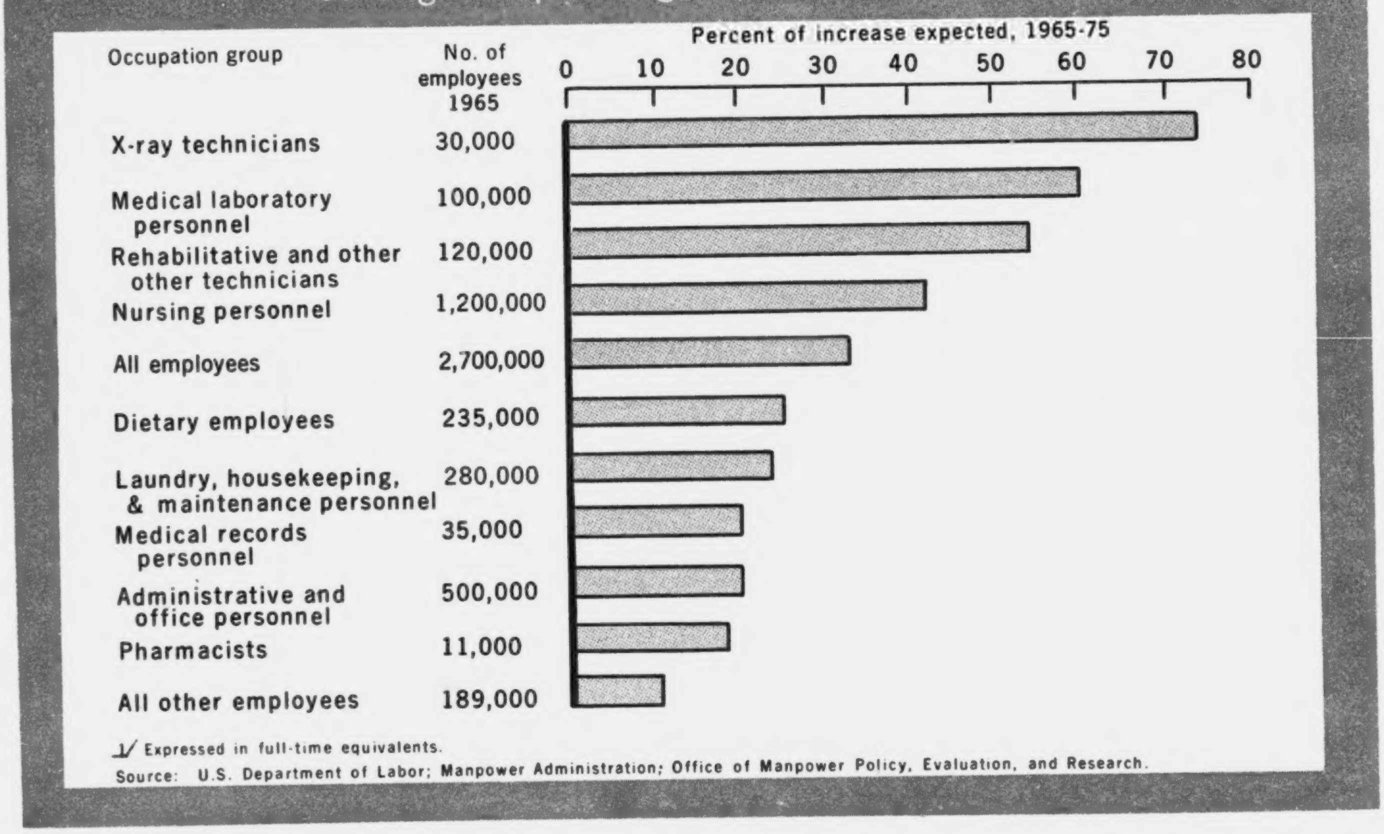

Chart 1. Growth in employment[1] will vary widely among occupation groups in next decade.

1/ Expressed in full-time equivalents.

Source: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research.

The total number of employees in the health service industry will increase rapidly over the next 10 years. The increase will vary among health occupational groups; growth will be highest among X-ray and laboratory technicians, lowest for office personnel, laundry workers, and similar categories.

Many new jobs are appearing in the health service field. Examples of these are the inhalation therapist and personnel needed to operate and repair computer installations and other medical electronic equipment. Entirely new categories of health personnel may emerge. Some of these—such as the "assistant physician"—are now mainly in the trial or discussion stage. In long-established occupations, particularly those in the nursing profession, constant needs for changes and adjustments in job content and orientation will result from adoption of new equipment and techniques.

In general, the effects of changing technology on health manpower will be felt gradually. Little by little, as new equipment and techniques are introduced in more and more hospitals over the next 5 to 10 years, content of health jobs will change and new jobs will appear. The pace will accelerate as time goes on, but it is not likely that demands for workers with altogether new skills will outstrip the capacity for training them under existing or widely recommended long-range plans. Nor is it likely that the spread of laborsaving innovations will cause workers in any category to lose their jobs.

The laborsaving effects of technological change in the health service industry will probably do little to alleviate existing and continuing shortages of health manpower. Current and future shortages will have to be met by provisions for expanding the supply of health workers, such as:

1. Removing wage and related inequities and providing other incentives to attract back to employment the many inactive *already qualified* nurses and other highly trained persons and to keep those presently employed in the health industry from leaving;

2. Expansion of MDTA and other Government and private programs (including refresher courses) for training health professionals, subprofessionals, and auxiliaries to fill existing vacancies; and development of programs to provide upgrading and similar career development training, and other programs to improve health manpower utilization;

3. Expanded efforts among agencies concerned at all levels of government, and by private organizations, to coordinate policies on priorities for dealing with shortages of health manpower, and to improve machinery for the collection and dissemination of statistical and other information on the problems involved.

Unless such steps are taken, existing shortages of health manpower are likely to become greater during the next few years.

# 1

# Manpower In Health Facilities

The outlook for the amount of manpower needed and requirements for jobs in the health service industry depends on expectations regarding the expansion of demand for health services and the emergence of new technological developments, as these factors interact with the basic characteristics and problems of health service employment.

## Trends in Health Service Expenditures and Facilities

The most basic trend in the outlook for health manpower is the rise in general demand for health services. Rapid expansion in demand is evident from many indications. In particular, it has been shown by the growth in consumer expenditures for health care, which has been even more rapid than the growth in capacity of facilities that care for patients. Significant changes in patterns of demand have occurred, as indicated by shifts in importance among the types and services of health facilities being used. Continued rise in general demand and change in the character of needs for patient care will have important effects on the number and kinds of manpower required in health facilities.

### Health Service Expenditures

During recent years, the increase in the proportion of the gross national product spent on health and medical care has been rapid. Including both consumer and public outlays, the proportion rose from 4.6 percent in 1950 to 5.9 percent in 1964, an increase of more than 28 percent.[1] This has reflected growth in activity (and jobs) in all types of health service facilities: Hospitals, nursing homes, offices and clinics of private professional practitioners, medical and dental laboratories, and other public and private facilities.

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[1] Source: Social Security Administration. (See app. table C-1.)

Increased health care spending in the last few years reflects not only increased demand, but also the rising consumer costs of medical care. Between 1957–59 and 1964, the index of prices for medical care increased 19 percent compared with a rise in the index of all consumer prices of 10 percent. Price trends for individual medical items and services have varied: Costs of prescriptions and drugs declined 2 percent, surgical fees for tonsillectomies went up 19 percent, but charges for hospital rooms rose 45 percent.[2]

A major share of private expenditures for health care has channeled through various forms of prepaid health insurance. The most widespread form of such coverage has been hospital expense protection as purchased by individuals, employers, and organizations. By 1964, 79 percent of all individuals in the United States were covered by partial or complete hospitalization insurance. Many of them were also protected by various forms of private medical insurance.[3]

The Medicare programs, signed into law in 1965, extend basic hospital and medical protections to persons 65 years old and over. Steadily increasing numbers of aged persons will apply for benefits under these programs in the next few years. This will swell the demand for health services in every community. It has been estimated by many authorities that these programs will result in an average increase of about 5 percent in demand for hospital beds and other services. In some communities, the increase will be higher, in others lower. Other new health care programs, such as Federal-State provisions for services to the medically indigent and expanded health protection under the heart disease, cancer, and stroke program will further spur the demand for health services.

## *Hospitals and Other Health Service Facilities*

***Definition of Health Service Industry.*** In this study, health service activity is defined in terms of the industry concept, as an adaptation of definitions set up by the Standard Industrial Classification (SIC)—a classification system developed by the Federal Government and other statistical authorities. Establishments included in the health service industry as here defined are exclusively facilities that perform patient care functions. They include: Both private- and government-owned hospitals and nursing homes, the offices and clinics of private medical and other individual practitioners and groups, and privately-operated medical and dental laboratories. All employees in these establishments are included in employment figures used in this study, consequently, both employees in direct patient care functions and in functions or occupations not directly concerned with patient care (laundry, etc.) are included as health manpower.

The health service industry as referred to in this report is defined in detail in the appendix. It is wider in scope than SIC 80 Medical and Other Health Services, which excludes the government-owned hospitals and nursing homes included in this study. But the scope of the industry as defined here is narrower than some interpretations of kinds of employment that utilize health manpower. Several types of health-related activity carried on by governmental units (other than hospitals or nursing homes)—such as regulatory, informational, environmental, and other public health programs—often considered to be included in the health service industry, are not included in the definition used here.

This study is mainly concerned with employees on payrolls in patient care establishments. The employment statistics presented later do not include self-employed professionals, proprietors of health establishments, or students, volunteers, or other unpaid personnel.

***Health Facilities: Number and Use.*** Approximately 7,100 hospitals, with capacity for 1.7 million beds, are registered with the American Hospital Association.[4] New hospitals are constantly being built, but since older hospitals are continually being remodeled or abandoned, the number of hospitals and hospital beds rises slowly. Between 1955 and 1964, the net increase in number of hospitals was only 3 percent; the increase in hospital beds, only 6 percent.

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[2] Source: U.S. Department of Labor, Bureau of Labor Statistics. (See app. table C-1.)

[3] Source: Health Insurance Council. (See app. table C-1.)

[4] The source of data on hospitals in this section is the American Hospital Association (AHA). The data are summarized in app. tables C–2, C–3, and C–4. In addition to the 7,100 AHA-registered hospitals, there are well over 1,000 nonregistered hospitals, infirmaries, and similar units most of which are known to be smaller than most registered hospitals. Data on other health facilities are taken from the "County Business Patterns" studies of the U.S. Department of Commerce and studies on nursing homes by the Public Health Service.

Hospitals differ widely in regard to the type of health care they provide. Four out of five hospitals are short-term general hospitals which provide patients with care for acute illnesses, births, and the other recurring needs of people for hospitalization. The remaining hospitals chiefly serve long-term patients, especially those requiring treatment for mental illnesses and tuberculosis. Over the past decade, the number of short-term general hospitals has grown much more rapidly than others. Differences in the pattern of utilization of different types of hospitals are shown by the figures in table 1, which compare the percentage breakdowns in 1964 of bed patients in the Nation's hospitals on an average day (average daily patient census) with data on patients admitted and on outpatients cared for.

Patients in short-term general hospitals on any given day command the use of slightly more than a third of all hospital beds. Nine out of ten hospital admissions are to short-term general hospitals. It is the short-term hospitals to which most people go when they are in need of care, usually for brief stays (average 7.7 days). Also, these hospitals provide most of the outpatient care given by the Nation's hospitals.

About half of all hospital beds in the United States are usually occupied by psychiatric patients. This percentage includes beds in Federal hospitals and psychiatric wards in general hospitals, as well as those enumerated in the total hospital patient census that are in psychiatric hospitals. (See table 1.)

The patterns of hospital use in 1964 reflect various changes from those of 1955. Over the decade, the number of admissions to all hospitals rose 34 percent. However, admissions to tuberculosis hospitals dropped 29 percent, and average daily patient census and outpatient visits in tuberculosis hospitals also declined sharply. Another significant development was the general rise in outpatient visits. In 1964, the total number of such visits was 70 percent higher than in 1955. Outpatient visits in psychiatric hospitals that same year were up phenomenally, to a level 146 percent higher than 10 years earlier.

### TABLE 1. PATTERNS OF HOSPITAL UTILIZATION, 1964

[Percent]

| Type hospital | All average daily patient census | All patient admissions | All outpatient admissions |
|---|---|---|---|
| All hospitals | 100 | 100 | 100 |
| Federal hospitals | 11 | 6 | 25 |
| Non-Federal short term | 38 | 92 | 72 |
| Non-Federal psychiatric | 45 | 1 | 1 |
| Non-Federal tuberculosis | 2 | (1) | 1 |
| Non-Federal long term | 4 | 1 | 1 |

[1] Less than 0.5.

SOURCE: American Hospital Association.

Number of beds in a hospital is the commonly used indicator of hospital size. Hospital sizes range from fewer than 25 beds to well over 2,000. The average number of beds in all non-Federal hospitals in 1964 was 227. Type of patient care offered was a major factor influencing differences in average hospital size, as shown by the following figures on non-Federal hospitals:

| *Type of non-Federal hospital* | *Average number of beds* |
|---|---|
| Total | 227 |
| Short-term general and other special hospitals | 126 |
| Psychiatric hospitals | 1,419 |
| Tuberculosis hospitals | 214 |
| Long-term general and other special hospitals | 230 |

The largest hospitals, by far, are the psychiatric institutions. Short-term general and other special hospitals average not much more than 100 beds, but many large institutions are included in this group. In 1964, 155 hospitals with 500 or more beds accounted for one-sixth of all beds in short-term general hospitals.

From the standpoint of ownership and control, the largest group of hospitals are those owned by religious, charitable, and similar organizations, and known as "voluntary" hospitals.

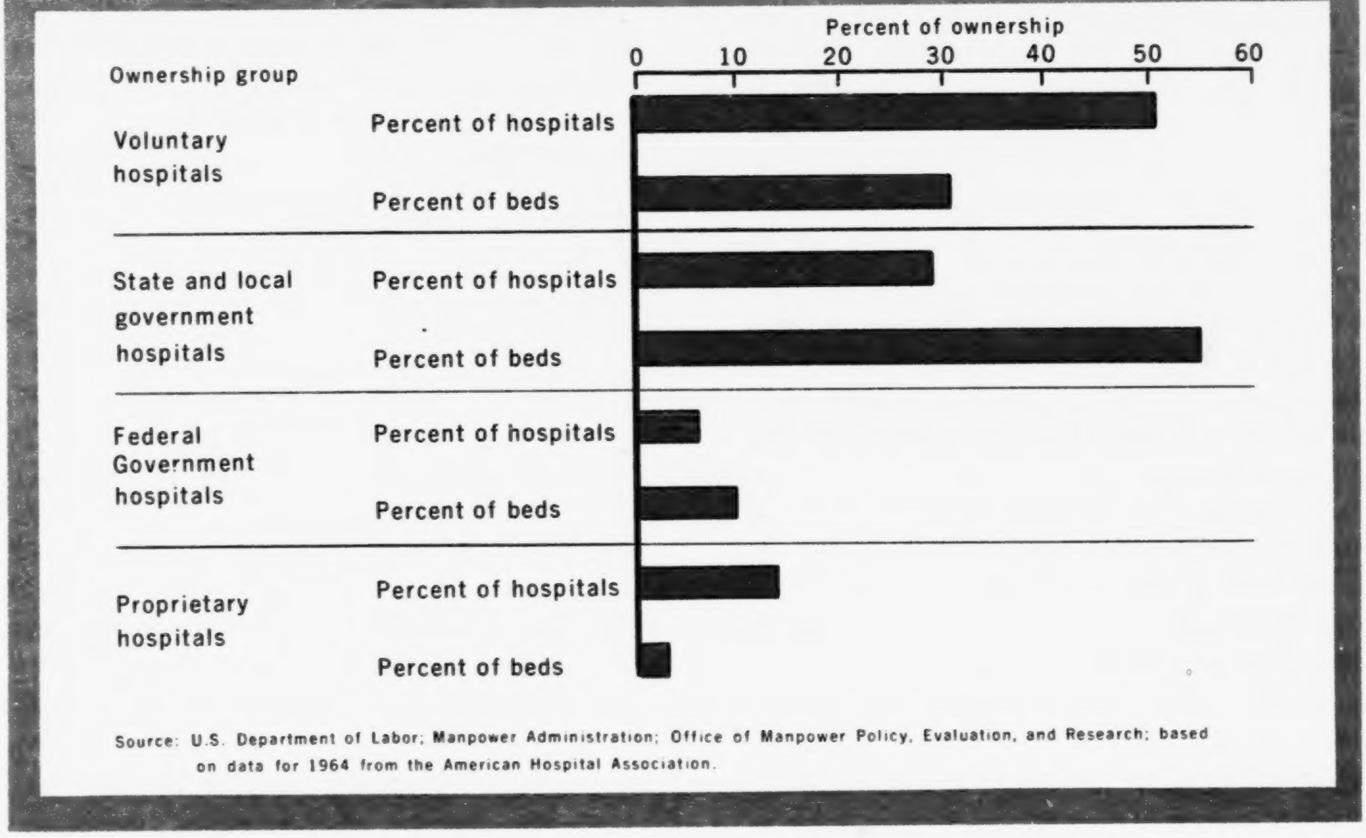
These constitute 51 percent of all hospitals and provide 31 percent of all hospital beds. They are mainly short-term general hospitals. Most other hospital beds are in State and local government hospitals, many of which are mental institutions. The remaining beds are in Federal Government and proprietary hospitals, i.e., those owned by private individuals or groups. (See chart 2.)

Available information on the number of nursing homes and beds they provide is incomplete. According to a comprehensive study for 1961, about 10,000 homes with 350,000 beds had skilled nursing care available. Another 13,000 nursing homes, rest homes, and homes for the aged, with 250,000 beds, provided mainly "personal care"; only a small minority of these were staffed to provide skilled nursing care. Since 1961, the number and bed capacity of nursing homes has been increasing rapidly and the proportion of rest homes providing nursing care is believed to be increasing. Preliminary information from recently conducted studies indicate that in 1965 about 500,000 beds in homes provided some amount of nursing care.

Most nursing homes are small. Median bed capacity in 1961 was 25 beds. Nine out of ten nursing and rest homes are owned and operated by proprietors on a profit-risk basis; the rest are run by nonprofit organizations and by State and local governments.

Employment per hospital and nursing home varies according to type of service. Average employment per hospital was 265 in 1964. Average employment per Federal hospital was 438; in short-term general hospitals, which include more than three-fourths of all hospitals, the average number of employees was 233. The largest hospitals in terms of average number of employees were the psychiatric hospitals, with 542 employees; the smallest were the long-term general and tuberculosis hospitals, with 223 and 160 employees, respectively. Most nursing homes have much smaller staffs than hospitals, but some homes, especially those providing

Chart 2. Religious, charitable, and other voluntary groups lead as hospital owners.



Source: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research; based on data for 1964 from the American Hospital Association.

skilled nursing care, have as many employees as the average long-term hospital.

In 1962, physicians, osteopaths, dentists, optometrists, and other practitioners provided health service of various kinds in approximately 150,000 offices and clinics, nearly all of which had fewer than four employees. There were approximately 2,000 privately owned medical laboratories, and 3,500 dental laboratories. In these establishments, the size of staffs was larger, on the average, than in practitioners' offices. In about a third of them there were seven or more employees. A few practitioners' offices, clinics, and laboratories employ as many as 100 or more workers.

## *Employment in Health Service Establishments*

A hospital combines some of the functions of a hotel, a group of physicians' offices, and a scientific research center. All of these functions, and many others, are reflected in their organizational patterns and the occupations of their employees, which range from highly skilled professional positions to jobs unskilled beginners can fill.

Despite wide variations in occupations and training, most hospital employees and other health service workers face one group of common problems—low earnings and frequently unsatisfactory working conditions. These problems have contributed toward difficulties in recruiting and holding workers in the health service industry.

### *Organization and Staffing of Health Facilities*

The organization of a short-term general hospital shown in chart 3 is a simplified representation of organization which may be typical of many institutions having about 500 beds and 1,000 employees. The management of the hospital is directed by a chief executive officer, usually called the administrator, who is responsible to a governing board. The administrator is aided by assistant administrators in charge of departments concerned with business management and services. The administrator coordinates these activities with those of directors of the medical care, nursing, and dietary departments. In most institutions, the medical director is responsible to the administrator only in regard to major administrative and financial questions, and on all other matters reports directly to the governing board.

The medical director coordinates the service of staffs of physicians, surgeons, dentists, pharmacists, technicians, therapists, and other professional personnel. Approximately 15 percent of the hospital's employees are under his supervision or that of his subordinates. Most of the medical, surgical, and dental staff are independent practitioners, rather than employees of the hospital, and maintain offices outside the hospital.

The director of nursing has assistant directors responsible for such functions as nursing education, evening shifts, and other general or special services. In addition, there are many intermediate-level nursing supervisors. Altogether, nursing personnel accounts for nearly half of all employees in the hospital. Included in it are professional nurses, practical nurses, nurse aides, ward clerks, and orderlies.

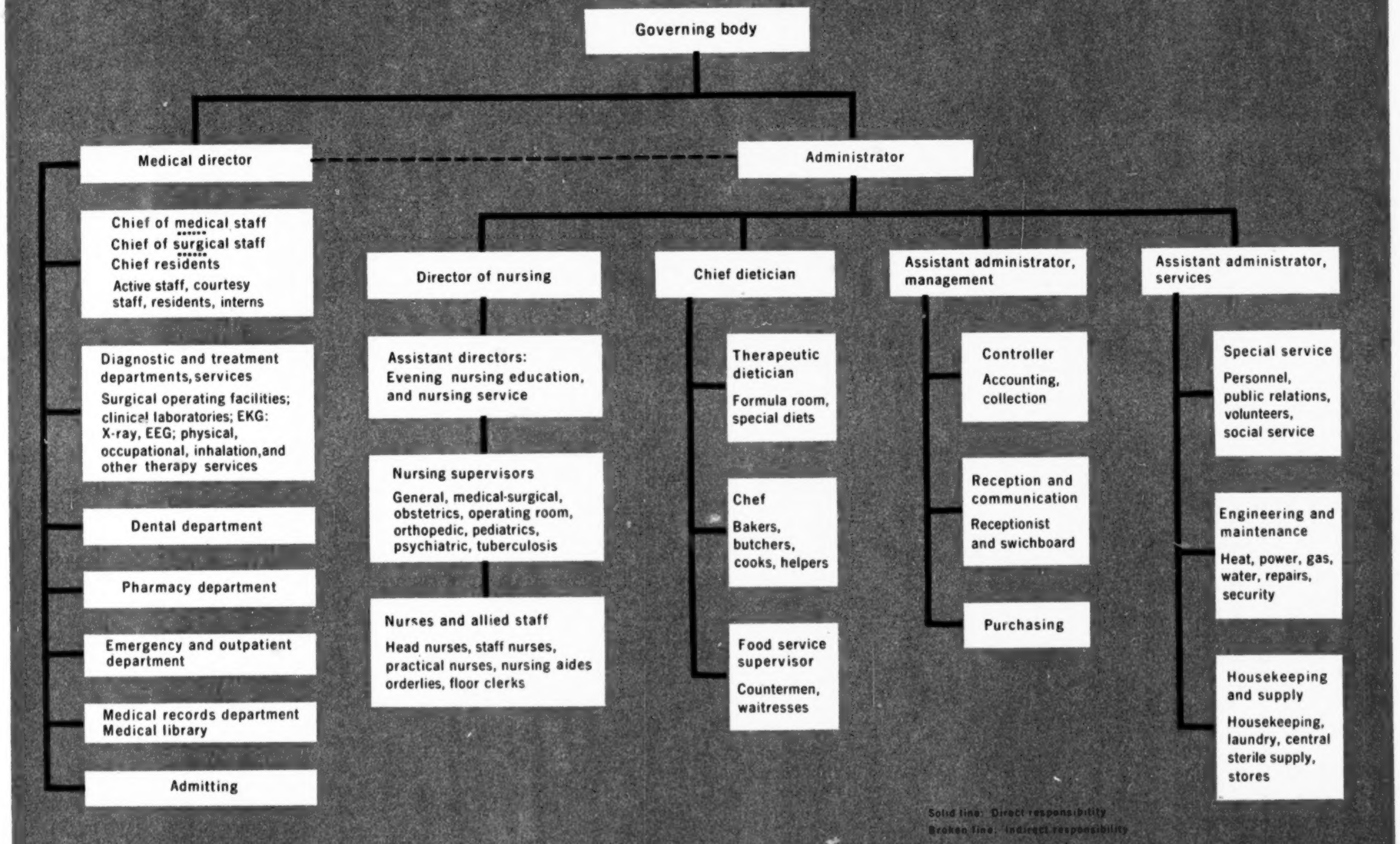
The chief dietician is responsible for all food preparation in the hospital, not only in kitchens and dining rooms, but also in special areas set aside for the preparation of infant formulas and special diet items. Over 10 percent of all employees of a hospital are in the dietary department. Most of them are semiskilled and unskilled workers.

The business management departments of the hospital employ many different kinds of white- and blue-collar personnel, in skilled, semiskilled, and unskilled categories. About a fourth of all hospital employees are employed in these departments.

Most general hospitals differ in some respects from the structure shown in chart 3. For example, social service is sometimes under the medical director's jurisdiction. Central sterile supply is sometimes attached either to nursing services or to pharmacy; in some older hospitals it is not set up as a separate unit. Instead, its functions are divided among the nursing and other departments.

Specialized hospitals, such as maternity, chil-

Chart 3. Typical large general hospital organized into five divisions.


Governing body
Medical director
Administrator
Chief of medical staff
Chief of surgical staff
Chief residents
Active staff, courtesy staff, residents, interns
Diagnostic and treatment departments, services
Surgical operating facilities; clinical laboratories; EKG: X-ray, EEG; physical, occupational, inhalation, and other therapy services
Dental department
Pharmacy department
Emergency and outpatient department
Medical records department
Medical library
Admitting
Director of nursing
Assistant directors: Evening nursing education, and nursing service
Nursing supervisors
General, medical-surgical, obstetrics, operating room, orthopedic, pediatrics, psychiatric, tuberculosis
Nurses and allied staff
Head nurses, staff nurses, practical nurses, nursing aides orderlies, floor clerks
Chief dietician
Therapeutic dietician
Formula room, special diets
Chef
Bakers, butchers, cooks, helpers
Food service supervisor
Countermen, waitresses
Assistant administrator, management
Controller
Accounting, collection
Reception and communication
Receptionist and swichboard
Purchasing
Assistant administrator, services
Special service
Personnel, public relations, volunteers, social service
Engineering and maintenance
Heat, power, gas, water, repairs, security
Housekeeping and supply
Housekeeping, laundry, central sterile supply, stores
Solid line: Direct responsibility
Broken line: Indirect responsibility

Source: U.S. Department of Labor, Manpower Administration; Office of Manpower Policy, Evaluation, and Research.

dren's, psychiatric, and tuberculosis hospitals, show characteristic differences from the general hospital in size, organization, and personnel.

Nursing homes are generally smaller and simpler in organization than hospitals. The typical home that provides skilled nursing care has 30 to 35 beds and 15 employees. About half of the staff consists of nursing personnel. Usually one or two of this group are registered or practical nurses; the rest are nurse aides and orderlies. In some cases, the owner of the home is a nurse who directs the care of patients in addition to giving general supervision. More often, the owner acts as a general manager only. Aside from the nursing personnel, the staff consists of workers who do housekeeping, food preparation, and food service. A very small number of homes have physicians or physical therapists on the salaried staff, on either a full- or part-time basis. More often, other arrangements are followed in obtaining such professional services.

Offices of physicians and dentists vary in size, depending on whether these professionals are practicing in solo, partnership, or group practice arrangements. In many instances, physicians and dentists in solo practice have no regular employees, or at most a secretarial assistant and a dental or medical assistant or technician. In some physicians' offices one person provides secretarial assistance and also performs some clinical laboratory tests and other technical tasks. Most offices of private physicians, dentists, and other practitioners working in partnership or other shared arrangements are simple in organization and do not employ more than three assistants, such as secretary-receptionist, bookkeeper, and technician (or hygienist).

Group medical practice has attracted a steadily rising number of doctors and has increased the needs for other health workers. According to a 1959 survey, 1 in every 8 physicians in private practice is now in group practice. Most of these are employed by health plan organizations. Their offices and clinics vary greatly in size and organizational complexity. Many paramedical health workers are employed in these groups. According to this same survey, the types of specialized personnel most often employed included: Registered nurses, licensed practical nurses, nurse aides, X-ray technicians, laboratory technicians, and physical therapists. Some groups also employed social workers, dieticians, medical records personnel, opticians, and psychologists.[5]

## *Employment in Health Service Occupations*

As a first step toward seeing the problems and trends of health manpower in perspective, it is useful to look at the different kinds of occupations and establishments that provide patient care services and the number of jobs they represent. Table 2 shows estimated employment in 1965 (in terms of full-time equivalents for both full- and part-time workers) in 27 important jobs and groups of occupations in the main branches of the health service industry. Included are 18 occupations (or groups) designated as "health occupations," (categories 1–6, table 2), which require skills primarily needed in the health service field, and 9 others (categories 7–10, table 2) that include many jobs in which the skills called for may also be utilized in other industries. Lines cannot be drawn sharply between the two groups of jobs. Both are considered within the category of "health manpower" for purposes of this study.

The total number of jobs in the health service industry, as it is defined in this study, is estimated at 2.7 million in 1965 in full-time equivalent terms (all full-time jobs plus half of the part-time jobs). About three-fourths of this number—2 million—were in hospitals. Another 250,000 were in nursing homes. Offices and clinics of physicians, dentists, and other practitioners, together with medical and dental laboratories and related establishments, accounted for 450,000.

Over a million health jobs, nearly half of the industry total, were held by nursing personnel, including nearly 500,000 professional nurses, 200,000 practical nurses, and over a half million nurse aides, orderlies, and attendants. The many other professional and technical occupations account for only a small proportion of the employment in the health service industry—less than 300,000 jobs. Other occupations that

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[5] S. D. Pomrinse and M. S. Goldstein, "The 1959 Survey of Group Practice," *American Journal of Public Health,* May 1961.

Table 2. Estimated Employment in Health Service Industry Establishments, by Occupation, 1965 [1]

| Occupation | All health service establishments | Hospitals | Nursing homes | Private offices, laboratories, clinics, etc. |
|---|---|---|---|---|
| Total employment | 2,700,000 | 2,000,000 | 250,000 | 450,000 |
| Nursing personnel | 1,200,000 | 945,000 | 155,000 | 100,000 |
| Professional nurses | 460,000 | 385,000 | 20,000 | 55,000 |
| Practical nurses | 200,000 | 150,000 | 25,000 | 25,000 |
| Nurses aides, orderlies, etc | 540,000 | 410,000 | 110,000 | 20,000 |
| Laboratory personnel (medical) | 100,000 | 80,000 | (2) | 20,000 |
| Medical technologists, technicians, scientists | 60,000 | 55,000 | (2) | 5,000 |
| Lab assistants (certified, semiskilled etc) | 25,000 | 15,000 | (2) | 10,000 |
| Lab helpers, orderlies, etc | 15,000 | 10,000 | (2) | 5,000 |
| X-ray technologists | 30,000 | 22,000 | (2) | 8,000 |
| Pharmacists | 11,000 | 10,000 | (2) | 1,000 |
| Rehabilitative and other technicians | 120,000 | 61,500 | 4,500 | 54,000 |
| Physical therapists | 11,000 | 8,500 | 1,000 | 1,500 |
| Occupational therapists | 7,000 | 5,500 | 1,000 | 500 |
| Speech and hearing technicians | 3,000 | 1,000 | (2) | 2,000 |
| Psychologists, social workers, counselors | 32,000 | 23,000 | 1,000 | 8,000 |
| Inhalation therapists | 3,000 | 3,000 | (2) | (2) |
| Dental hygienists | 10,000 | 2,000 | (2) | 8,000 |
| Dental lab technicians | 14,000 | 2,000 | (2) | 12,000 |
| Optometrists, opticians (incl. mechanics) | 15,000 | (2) | (2) | 15,000 |
| Other, misc | 25,000 | 16,500 | 1,500 | 7,000 |
| Medical records personnel | 35,000 | 32,000 | 500 | 2,500 |
| Dietary personnel | 235,000 | 205,000 | 30,000 | (2) |
| Dieticians and nutritionists | 20,000 | 18,000 | 2,000 | (2) |
| Other dietary workers | 215,000 | 187,000 | 28,000 | (2) |
| Laundry, housekeeping and maintenance | 280,000 | 248,000 | 30,000 | 2,000 |
| Laundry workers | 45,000 | 39,000 | 6,000 | (2) |
| Housekeeping and supply workers | 140,000 | 122,000 | 18,000 | (2) |
| Building engineers and craftsmen | 60,000 | 56,000 | 3,000 | 1,000 |
| Porters, elevator operators, etc | 35,000 | 31,000 | 3,000 | 1,000 |
| Administrative and office workers | 500,000 | 250,000 | 20,000 | 230,000 |
| Administrators and managers | 45,000 | 12,000 | 14,000 | 19,000 |
| Bookkeeping, secretarial and misc | 455,000 | 238,000 | 6,000 | 211,000 |
| All other, misc | 189,000 | 146,500 | 10,000 | 32,500 |

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[1] Excludes physicians, dentists, and persons not on payrolls. All figures are full-time equivalent employment.

[2] Few, if any, employees.

Source: Estimates (see text and Statistical Appendix).

account for large numbers of employees include the administrative and office category (about 500,000), and workers in dietary, laundry, housekeeping, and maintenance jobs (over 500,000).

The figures in table 2 include only employment on payrolls in the health service industry as it is defined in this study, estimated in full-time equivalent terms. If estimates were included of the total number of persons in part-time jobs in the health service industry, and if self-employed persons, as well as all other persons in health-related jobs in government or private industry establishments of all kinds were included, the total count of persons in health jobs would probably approach 4 million. Physicians and dentists, the leaders of the health profession, were omitted from the table mainly because most of them are self-employed; a relatively small number of residents and interns are actually on the payrolls of hospitals, but are in a separate category from hospital employees. In 1964, the total number of active physicians was about 275,000; the total number of active dentists was about 95,000.[6]

## *Labor Costs vs. Employee Earnings*

Employment in the health service industry has grown rapidly during the past decade, at a much sharper rate than the rise in the patient load. According to the American Hospital Association, employment in hospitals rose 61 percent from 1955 to 1964. In contrast, the number of patients cared for, as shown on the average daily census of patients, increased only 4 percent. The employee/patient ratio computed for all hospitals went up from 0.95 in 1955 to 1.33 in 1964. Increases in this ratio occurred in all types of hospitals (by 1964 the ratio was 2.4 in short-term general hospitals but somewhat lower in other types).[7]

During the decade, wage rates of hospital employees also rose rapidly. This increase is reflected in a rise of the payroll average per employee of nearly 54 percent. The proportion of total expenses in hospitals—always high in view of the fact that human effort is the chief input—rose from 64 percent in 1955 to 66.3 percent in 1964.

But although labor costs have risen sharply in hospitals as a result of increases in the size of their work force and in their pay rates, the earnings received by health service workers generally have lagged behind those of other groups of workers. According to the U.S. Department of Commerce, average earnings of health service workers have risen at the same rate (44 percent) as the average for all workers during the past decade, so the traditional marked difference between levels of earnings of health service workers and workers in all industries has not been changing. Average yearly compensation of health service workers in 1962 was $3,439, compared with an average for all employees of $5,449.[8] The continuing gap in the earnings averages shown by these figures is accounted for only partly by the omission of some highly paid categories (physicians, dentists, etc.) from the health service employee group. The

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[6] Sources of estimates of employment in table 2 and in the text are given in the Statistical Appendix. It should be emphasized that large numbers of workers in some of the health occupations listed in table 2 are employed in establishments outside of the health service industry as defined here. Specifically, in addition to the 10,000 pharmacists and 15,000 optometrists and opticians shown in table 2, about 100,000 pharmacists and 20,000 optometrists and opticians were active in retail trade and manufacturing establishments. The following figures show the number of other professional or technical health workers active outside the health service industry as it is defined here (*in addition* to those indicated as employees of the health service industry in table 2). Professional nurses (150,000), practical nurses (65,000), medical laboratory personnel (27,000), X-ray technicians (40,000), dental laboratory technicians (10,000), dieticians (10,000), dental hygienists (3,000), speech and hearing technicians (12,000). Most of these health workers were employed in schools, custodial institutions, and outpatient health centers of government agencies, or were self-employed. Omitted entirely from table 2 are several other occupations included in some studies of health service employment: Veterinarians, chiropractors, industrial hygienists, and various categories of other workers in the fields of research and environmental health (such as chemists, sanitarians, etc.). Depending on which of these categories are included, their total number may range from 100,000 to 400,000. For fuller discussion of variations in estimates of total health manpower, depending on definition, see Statistical Appendix note 1.

[7] See app. table C-4.

[8] Source: Publications of the Office of Business Economics, U.S. Department of Commerce.

Table 3. Employees of Nongovernment Hospitals Earning Less Than $1.25 Per Hour, in Selected Occupations, 1963

| Occupation | Percent of employees earning less than— | | | |
|---|---|---|---|---|
| | $1.00 | | $1.25 | |
| | United States | South | United States | South |
| Nursing occupations: | | | | |
| Practical nurses | 1 | 3 | 11 | 31 |
| Nurse aides | 12 | 44 | 43 | 90 |
| Office occupations: | | | | |
| Payroll clerks | 0 | 0 | 2 | 5 |
| Switchboard operator-receptionists | 3 | 11 | 21 | 37 |
| Switchboard operators | 1 | 4 | 13 | 45 |
| Transcribing machine operators | 1 | 3 | 6 | 11 |
| Service and other: | | | | |
| Chief housekeepers | 0 | 0 | 2 | 10 |
| Finishers, flatwork, machine | 21 | 60 | 54 | 96 |
| Kitchen helpers | 20 | 63 | 55 | 96 |
| Maids and porters | 17 | 61 | 48 | 96 |
| Washers, machine | 7 | 25 | 28 | 70 |
| Dishwashers, machine | 22 | 61 | 58 | 97 |

Source: U.S. Department of Labor (see footnote 9).

main reason for the disparity is simply the fact of lower rates of pay for jobs requiring comparable skill or training in health service than in other industries or occupations.

## *Wages, Hours, and Working Conditions*

The low average earnings in the health service industry reflect the presence of a very large proportion of employees who receive subnormal rates of pay. The prevalence of low-paid workers, especially in voluntary hospitals and other privately operated facilities, contributes toward keeping the salary structure low throughout the health service industry.

Studies in nongovernment hospitals conducted in 1963 by the Bureau of Labor Statistics and the Wage and Hour and Public Contracts Divisions of the U.S. Department of Labor show that substantial proportions of the workers in several occupational groups, which account for large proportions of total employment, earned less than $1.25 per hour.[9] As table 3 shows, the proportion of hospital workers at low wage levels is particularly high in the South.

Most hospital employees work 40 hours weekly and are paid for overtime work either at their regular rate or are permitted equal time off from work. Hospital workers, especially those who provide direct patient care, must often work Saturdays and Sundays. Many hospital workers—about a fifth of the professional nurses, smaller proportions of other groups—must work late shifts. Those who work on second and third shifts usually receive shift differentials of $5 to $10 per week.

Some hospitals provide free meals, uniforms, and laundering of uniforms to certain employees, especially to kitchen helpers, but very few provide free uniforms to nurses. Most hospital workers are entitled to some sick leave, and to hospitalization and medical benefits. Some form of retirement pension plan is also available to most hospital employees.[10]

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[9] *Industry Wage Survey; Hospitals, Mid-1963* (Washington: U.S. Department of Labor, Bureau of Labor Statistics, June 1964), Bulletin 1409; and *Nongovernment Hospitals* (Washington: U.S. Department of Labor, Wage and Hour and Public Contracts Divisions, January 1965).

Wages of employees in nursing homes, practitioners' offices, and laboratories tend to be more or less the same as those of nongovernment hospital workers in comparable occupations and localities.

*Minimum Wage Coverage.* Because of statutory exemptions, employees of nongovernment hospitals and nursing homes did not become subject to the Federal Fair Labor Standards Act until February 1967. A small proportion of hospital workers have been covered by the State minimum wage laws in 24 jurisdictions (22 States and the District of Columbia and Puerto Rico), but the protection is limited in various ways in many of these States. Only in nine States is the minimum $1.25 or more.

The Fair Labor Standards Act was amended in 1966 to become effective February 1, 1967 to cover hospital workers. The amendments provided for a minimum hourly wage for hospital and nursing home workers and provided for overtime rates of pay after 44 hours per week with certain exceptions. The amendments provide for a minimum wage of $1.00 hourly for these newly covered workers effective in 1967, rising gradually, in four additional steps, to $1.60 in 1971. In its present form, provisions of the legislation will have only moderate effects in the short run on existing pay differentials between employment in hospitals and nursing homes and other industries, for under the same new law, minimum wage levels for workers already covered became $1.40 on February 1, 1967, and will step up to $1.60 on February 1, 1968. Substantial differences between the earnings of health service workers and workers in nonhealth jobs will continue for a long while.

*Collective Bargaining.* No satisfactory estimate is available of the number of hospital workers covered by collective bargaining agreements, but it may be in the range of 100,000 to 300,000.

The file of collective bargaining agreements maintained at the Bureau of Labor Statistics, collected on a voluntary basis, included 21 collective bargaining agreements covering hospital and nursing homes workers in 1965. The total number of workers covered by these 21 agreements was approximately 16,000. Included were various types of agreements. Some were contracts covering professional nurses only, negotiated between hospital employers and affiliates of the American Nurses' Association in several States; others were agreements covering groups of nonprofessional employees in Arizona, California, Minnesota, Missouri, and New York who were represented by one of the following unions: Building Service Employees' International Union (BSEIU); Retail, Wholesale and Department Store Union; Hotel & Restaurant Employees and Bartenders International Union; International Union of Operating Engineers. A union spokesman for the BSEIU stated in 1962 that that the total number of hospital employees represented by the union was 75,000.

Substantial numbers of hospital employees are represented by unions of government workers, such as the American Federation of Government Employees and the American Federation of State, County and Municipal Employees. Unaffiliated locals of the AFL–CIO are also believed to represent hospital workers in some cities.

Hospital workers are not covered by the National Labor Relations Act and therefore lack the collective bargaining protections provided under this law. A few States, such as Minnesota, Michigan, Wisconsin, and New York, have laws providing some forms of collective bargaining protection which cover workers in hospitals along with workers in other fields. Among the few other States that provide collective bargaining protection, certain classifications of hospital workers are excluded in some States; in others, all hospital workers are excluded.

Legislative proposals to amend the Federal labor relations law so as to remove the exemption of employment in hospitals have been introduced in Congress, but thus far have not been enacted.

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[10] *Industry Wage Survey; Hospitals, Mid-1963* (Washington: U.S. Department of Labor, Bureau of Labor Statistics, June 1964), Bulletin 1409.

***Social Security Programs.*** Social security coverage under the Federal old age and survivors program is voluntary for hospitals owned by nonprofit organizations or government units. Many such hospitals have elected coverage. Sixty percent of all employees in State and local government hospitals and about 95 percent in nonprofit hospitals are covered.

In only a few States are employees of nonprofit hospitals covered by unemployment insurance programs. In less than half of the States do employees of State and local governments receive such protection. President Johnson has urged the adoption of legislation which would remove the exemption of employment in nonprofit hospitals from tax provisions of the Social Security Act that relate to unemployment insurance and thereby help extend coverage of this program to employees of such hospitals.

Not more than half of the States require coverage of hospital workers under workmen's compensation laws and there appears to be little effort to extend this protection to them.

## Critical Needs for Health Manpower

A critical need for health manpower exists in many communities. In some occupations, such as registered nurse, licensed practical nurse, medical technologist, and a few others, the shortage is nationwide and is generally believed to be worsening.

Authoritative estimates of the size of the total nationwide health manpower shortage are lacking. According to some statements, as many as 500,000 to 1 million health service industry jobs are vacant, but these figures are probably much too high, considering that the total number of jobs in the health service industry is less than 3 million.

Opinions differ as to what yardstick should be used to determine the shortage. In many studies, the approach used is to estimate total manpower requirements in terms of a standard of desirable health care, and to determine the shortage by subtracting from that total the number of workers currently employed. Another approach, which is more realistic, is to estimate the number of vacant jobs employers are actually trying to fill. Efforts are currently being made to develop job vacancy statistics which may eventually result in satisfactory estimates of the national shortage of health workers. Meanwhile partial information from offices of public employment services, private employment agencies, employers, and other authorities leaves no doubt that the number of health job vacancies continues to be very large.

Reasons for the shortages of health manpower vary to some extent among occupations. A generally potent reason is the lack of attractiveness of pay and working conditions in health occupations by comparison with other jobs (see page 16). Many occupations in the health service industry require comparatively long periods of training. Incentives to attract recruits and facilities for training health workers have been insufficient to meet the need. During the last few years the Federal Government has begun to take steps toward overcoming shortages in health service occupations by enacting legislation such as the Manpower Development and Training Act of 1962, the Vocational Education Act of 1963, and the Nurse Training Act of 1964 and to provide new and expanded programs and facilities for training health workers, but much remains to be done.

### Seventeen Key Jobs

The U.S. Employment Service recently provided a list of occupations in critical demand, the *Career Guide For Demand Occupations,* which includes 17 health service occupations. The list is based on nationwide information developed by the Bureaus of Apprenticeship and Training, Employment Security, and Labor Statistics, and by the Women's Bureau, all of the Department of Labor.[11] The 17 health service occupations included on the list are shown in exhibit 1.

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[11] *Career Guide for Demand Occupations* (Washington: U.S. Department of Labor, Manpower Administration, Bureau of Employment Security, 1965).

### Exhibit 1—Health Manpower in Critical Demand, 1965[12]

| *Occupation* | *Basic Educational Requirement* |
|---|---|
| Physician | 7 to 8 years college and medical school plus 1 to 2 years internship. |
| Dentist | 2 year predental plus 4 years dental college. |
| Clinical psychologist | 5 years college plus 1 year experience or Ph. D. |
| Physical therapist | 4 years college plus 1 year special clinical training. |
| Occupational therapist | 4 years college plus 1 year clinical experience. |
| Dietician | 4 years college plus 1 year internship. |
| Pharmacist | 4 to 5 years college (at least). |
| Parasitologist | 4 years college (at least). |
| Chemist | 4 years college (at least). |
| Bacteriologist | 4 years college (at least). |
| Medical technologist | 4 years college (including 1 year technical training in accredited school). |
| Registered nurse | High School diploma plus 2 to 4 years nurse training. |
| X-ray technician | High school diploma plus 2 years in approved X-ray technology course. |
| Dental hygienist | High school diploma plus 2 years special course. |
| Dental technician | High school diploma plus 1 to 2 years dental laboratory school or on-the-job training. |
| Practical nurse, licensed | 2 years high school, plus 1 year school training, practical nurse course. |
| Ward attendant | High school graduate preferred, 6 to 12 months on-the-job training. |

A striking fact about training requirements in these occupations in critical demand is that they range from that of the physician, which requires 8 to 10 years of training beyond high school, to ward attendant, which requires only on-the-job training of several months. Most of these occupations call for moderate periods of training, ranging from high school equivalent or less (in the case of the practical nurse) to 4 to 5 years at the college level. All are open to both men and women, but men dominate some categories, such as physician and dentist, and women others, such as nurse and dietician. A broad range of health occupations attract substantial numbers of both men and women.

To cope with problems of shortages in specific occupations in particular communities and in the Nation, it is necessary to study the special circumstances in specific situations. It is not possible in this study to analyze problems affecting the many different health occupations and proposals for dealing with them. It seems best to focus on the shortages in a few particularly significant occupation groups. The sections that follow examine the problems of shortages among nursing personnel, a majority of all workers in health occupations, and medical laboratory personnel. The latter are in some ways generally representative of the health technician group, though most individual occupations in this group present special problems of their own.

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[12] SOURCE: U.S. Department of Labor, Manpower-Administration, Bureau of Employment Security, U.S. Employment Service.

### *The Nurse Shortage*

"A severe shortage of nurses exists in the United States today. It is both quantitative and qualitative. Quantitatively, the shortage makes it impossible to supply hospitals and other health facilities and organizations with sufficient numbers of adequately prepared nurses. Qualitatively, it impairs the effectiveness of nursing care." This statement is taken from a report on the problems of the nurse shortage and providing recommendations for meeting them. It was issued in December 1962 by the Surgeon General's Consultant Group on Nursing. The data, analyses, and recommendations in this report, entitled *Toward Quality in Nursing: Needs and Goals,*[13] constitute a major contribution toward an understanding of the general manpower situation in the health service industry, as well as problems specifically related to the nurse shortage.

One of the first facts to note about the nurse shortage is that there are three distinct groups of nursing personnel: (1) Registered nurses (R.N.s'), also called professional nurses and graduate nurses; (2) Licensed Practical Nurses (L.P.N.'s), also called "licensed vocational nurses;" and (3) Aides, attendants and orderlies, which include "nurse aids," "psychiatric aides," and others in auxiliary nursing capacities.

R.N.'s must pass State licensing examinations to be accepted for registration. Eligibility to take these examinations is limited to graduates of schools of nursing approved by State boards of nursing.

Registered nurses may be graduates of either of three different kinds of schools requiring 4, 3, or 2 years of study beyond high school. These courses are referred to as: "Baccalaureate" course (4 years college), "diploma" course (3 years hospital school), or "associate degree" course (2 years junior college).

Licensed practical nurses must be graduates of State-approved schools of practical nursing and must pass a State examination. Practical nurse training generally lasts 1 year and may be obtained in public vocational schools, high schools, or adult education programs. Approval of such training is given by State boards of nursing. In most States, completion of 2 years of high school or equivalent is required, and six States require a high school diploma.

Nurse aides and similar auxiliary personnel are not licensed, and are usually trained on the job or in brief vocational training courses.

Differences in job content between professional nurses, licensed practical nurses, and nurse aides are substantial, reflecting differences in education, skill, and responsibilities. The scope of each job is also determined partly by legal requirements and partly by custom in hospitals and other patient care facilities, which vary somewhat according to local circumstance and interpretation. Laws in many States restrict certain duties to registered professional nurses.

Standards maintained by professional nursing bodies, as well as widely used job definitions, distinguish among the levels of nurses and auxiliary personnel along these lines: Professional nursing practice refers to performance for pay of patient care and related duties, including the administration of medication and treatments as prescribed by physicians or dentists, based on substantial specialized skill and knowledge. Practice of practical nursing means the performance for pay of selected acts of patient care, under the direction of a professional nurse, physician, or dentist, not requiring substantial skill and knowledge. Auxiliary workers such as nurse aides can carry out certain essential time-consuming duties effectively and safely, under the direction of professional nurses or licensed practical nurses, but their activities are not considered to constitute the practice of nursing.[14]

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[13] *Toward Quality in Nursing: Needs and Goals* (Washington: The Surgeon General's Consultant Group on Nursing, 1963).

[14] *Statement on Auxuliary Personnel in Nursing Service* (New York; American Nurses' Association, April 1962).

Discussing the extent and effects of the nurse shortage, the report of the Surgeon General's Consultant Group quoted reports that in hospitals located in many areas as many as 20 to 30 percent of positions for professional nurses were vacant, and vacancies for practical nurses were also widespread. According to the report, "because the need for professional and practical nurses is increasing so much faster than the supply, hospitals have employed ever larger numbers of nursing aides, many of whom are inadequately trained. This pragmatic solution to the problem of shortages has produced an alarming dilution of the quality of service. In some hospitals the use of auxiliary workers has reached such extreme proportions that nursing aides give as much as 80 percent of the direct nursing services."

In the judgment of the Consultant Group, an adequate level of nursing care for the patient requires a ratio of 50 percent of patient care provided by professional nurses, 30 percent by practical nurses, and 20 percent by nursing aides. This standard is used in the report, in conjunction with other factors, to develop goals for expanding and improving the quality and supply of nursing personnel. The report examines major problems involved in achieving these goals, including the outlook for the supply-demand relationship in 1970, educational requirements for nurses, problems in utilizing nurse manpower effectively, and in recruiting nurses and students.

The report emphasizes the need for expanding the recruitment and training of professional nurse candidates. Its analysis of number of graduates expected to be produced by nursing schools indicates that a desirable goal of 850,000 professional nurses in practice in 1970 is unlikely to be met. A "feasible" goal of 680,000 is accepted as a compromise, with an implication that continued heavy reliance on practical nurses and nursing aides will be needed.

Among other aspects of the nursing profession examined was the quality of nurse training now being offered. The report concluded that "the present educational structure for the training of nurses lacks system, order, and coherence."

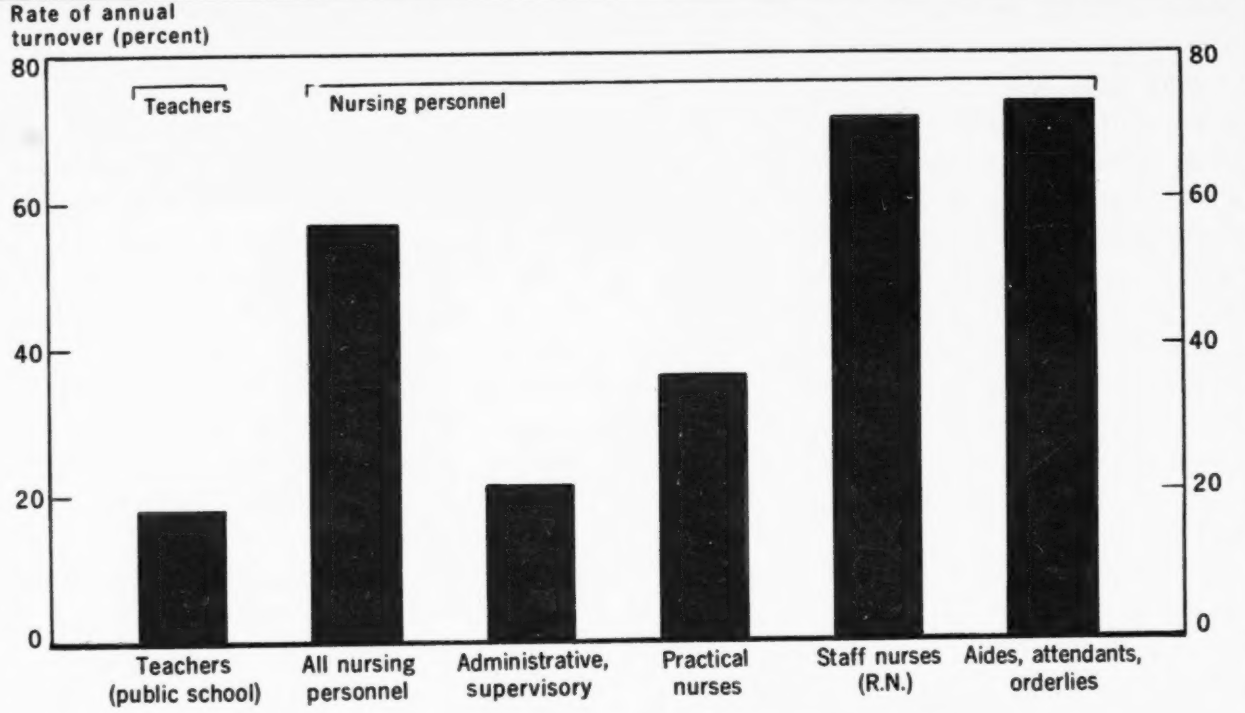
Measures suggested to make the best use of the present supply of nurses include improved administrative methods and staffing patterns in health facilities, and ways of making better use of nurses' time. The report discusses the need for incentives to bring inactive nurses back to the profession and to reduce turnover among nurses. It points out that an estimated half million women trained as professional nurses, many of them married women with young children, are not now practicing. The report suggests refresher courses and flexible arrangements of work hours to attract these women back to nursing.

Data are presented in the report showing that turnover rates among nursing personnel, approximately 60 percent per year, compare with a rate of 18 percent for female teachers in public schools. (See chart 4.) In discussing this contrast, the report draws attention to the difference to the median salaries of the two groups: $5,500 yearly for teachers, compared with $3,900 for staff nurses. Also discussed is the omission of nurses from the coverage of social security laws, collective bargaining protection, and other labor legislation. The report points out the need for improving the economic status of nurses in order to attract recruits and hold them.

The recommendations of the Consultant Group may be summarized as follows:

1. A study should be made of the present system of nursing education in relation to the responsibilities and skill levels required for high quality patient care, using funds from private and government sources.
2. The Public Health Service should expand its recruiting of nursing personnel, and should aid State and other agencies in their recruitment programs. Federal funds should be made available for student loans and scholarships.
3. Federal funds should be provided to help build schools of nursing and extend the development of new nursing education programs.
4. Programs in support of traineeships for baccalaureate and advanced degree candidates should be extended, using Federal funds.
5. Federal aid should be made available for demonstration projects and training to improve the utilization of nursing personnel and to strengthen in-service education and on-the-job training. Public Health Service programs which provide consultation and other services to health

Chart 4. Turnover of nurses dwarfs turnover of teachers.



Source: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research; based on data in "Toward Quality in Nursing Care," Report of Consultant Group to the Surgeon General.

facilities, to improve patient care through improved personnel utilization and other methods, should be expanded.

6. Programs providing Federal aid to research in nursing should be expanded.

The Nurse Training Act of 1964 translated into action several of the recommendations of the Consultant Group. It provided for: Grants for construction of schools of professional nursing; loans to students in associate, diploma, baccalaureate, or higher programs; payments to diploma schools of nursing to encourage expansion of their facilities; grants for projects to improve nursing instruction; and for extension of the professional nurse traineeship program providing tuition and other allowances for limited periods to nurses in qualified baccalaureate and advanced training programs.

These provisions of the act will contribute toward an eventual increase in the number of qualified R.N.'s, and toward improvement in the quality of nursing instruction. But the act is not likely to have more than a superficial effect on the nurse shortage for many years ahead.

In a recently published analysis of the Nurse Training Act of 1964 and its probable effects, Prof. Donald E. Yett of the University of California concluded that "this legislation will not be adequate to accomplish even its 'feasible goal' of preventing a further increase in the percentage of unfilled positions for professional nurses." In his view, the nursing shortage will persist as long as the salaries of nurses remain low in comparison with salaries in competitive careers for women (such as teaching and even secretarial jobs). Meanwhile, he recommends strengthening of the act by the development of a large nursing school scholarship program.[15]

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[15] Donald E. Yett, "The Nursing Shortage and the Nurse Training Act of 1964," *Industrial and Labor Relations Review,* January 1966, pp. 190–200.

The expansion of hospital programs for training practical nurses and nurse aides because of Federal and State Government assistance has helped to alleviate the effects of the continuing nurse shortage. Many nursing duties can be shifted to such workers, freeing the R.N., for work at a more professional level. Differences of opinion exist regarding the most desirable staffing ratios of R.N.'s to less fully trained personnel. But under prevailing conditions, the flow of trainees from projects provided under the MDTA and related legislation administered by the Department of Labor and the Department of Health, Education, and Welfare has made a very important contribution toward providing adequate patient care. It has kept in satisfactory operation some hospital wards that might otherwise have had to close altogether.

Leaders of the nursing profession continue to stress long-range goals in the programs they urge for the training of nurses. In a publication called "A Position Paper—Educational Preparation for Nurse Practitioners and Assistants to Nurses" (1965), issued by the American Nurses' Committee on Education, a program is presented which, if adopted, probably would have far-reaching effects, not only on the nursing education system, but also on the status of the great majority of nurses now in practice.

The program calls for a shift in nurse training away from a system relying substantially on hospital-based diploma programs toward one relying on college-level institutions of learning within the general system of education, and for major changes in the structure of nursing personnel. Currently, over 70 percent of nurse graduates are provided by the 3-year diploma programs.

The proposed approach involves a concept of two levels of nurse practitioners: (1) Professional nurses, educated in courses leading to the baccalaureate degree in nursing (4 years); (2) technical nurses, educated in courses leading to the associate degree in nursing (2 years). The new system would also provide for training of "assistants in the health service occupation," such as nurse aides, through short, intensive preservice programs in vocational education institutions. Existing diploma programs for training R.N.'s in hospital schools, and for training practical nurses in vocational schools, would be replaced by courses in senior and junior colleges that would utilize hospital facilities as laboratories. The nonprofessional "assistants" would also get some introductory practical training in hospitals after completing their courses in vocational schools and entering upon employment.

## *Medical Laboratory Personnel*

Modern medicine depends heavily on tests performed in medical laboratories. The specialist physician who directs the laboratory's procedures in a hospital and interprets findings is the pathologist.

The main work of the laboratory is done by the medical technologist, trained in scientific fundamentals and in laboratory techniques. With assistance from subordinates, the medical technologist carries on tests for a wide range of diseases, from noninfectious disorders, such as diabetes and leukemia (diseases whose presence can be positively identified only by laboratory tests) to contagious diseases, such as tuberculosis and syphilis. They conduct tests for pregnancy, make culture smears of body fluids, and analyze samples of blood and urine for a wide range of conditions. The tests involve chemical, bacteriological, physical, and other scientific principles. Laboratory personnel sometimes work under conditions of great pressure (for example, while surgery is proceeding on a patient), sometimes at the pace of ordinary routine. But at all times, their work is potentially of vast significance to the life, health, and general welfare of the patient.

There are various types and levels of medical laboratory jobs. It is important to emphasize certain distinctions among them, to avoid terminological confusion that has plagued discussion of these occupations for a long time. The following are the four basic distinct job titles, and the requirements that have been established by the American Medical Association (AMA), the American Society of Clinical Pathologists (ASCP), and the schools, registration boards, and professional organizations of laboratory personnel associated with these medical groups:

| *Title* | *Education or training* |
|---|---|
| Medical technologist, MT (ASCP). | 4 years college, including 1 year specialized training |
| Cytotechnologist, CT (ASCP). | 3 years college, including 1 year specialized training |
| Certified Laboratory assistant, CLA. | High school diploma plus 12 months training in an approved school |
| Histological technician, HT (ASCP). | High school diploma plus 12 months training in an approved laboratory |

All of these titles, which indicate fully acceptable professional or subprofessional status, require that graduates of training pass examinations to show they are qualified for registry or certification. Passing the exam enables them to use the professional initials after their names.[16] In addition to these titles, there are several other recognized medical technologist specialist categories which require at least a year of additional advanced training.

Terminological confusion usually develops from one of two sources. One is the fact that there are several self-constituted registries for medical laboratory personnel which lack recognition by organized medical groups but offer examinations and grant registration and privileges for use of certain initials after registrants' names. These groups commonly have standards distinctly lower than those of the ASCP, and in some cases register as "medical technologists" persons with brief, inadequate training in commercial laboratories. Another source of confusion is the continuing use of the term "medical technician" as a generic designation for persons who perform medical laboratory tests of any kind. In many doctors' offices, nurses or even secretarial assistants who have had little or no schooling in science or laboratory techniques learn on the job how to do some tests, and sometimes become known as "medical technicians."

During recent years, there has been a very big increase in the use of laboratory tests of all kinds, in conjunction with the examination of patients and for checking progress in their treatment. The supply of ASCP-registered medical technologists and cytologists, certified laboratory assistants and histological technicians has not kept pace with the expanded demand for their skills. Because of the shortage, commercial schools offering inadequate training courses are supplying personnel to many commercial laboratories, doctors' offices, and even some hospitals. Most of these schools train students in shortcut courses lasting 1 year or less, for fees ranging from $600 to $1,400.

Most urban hospitals avoid accepting graduates of these courses and other job applicants who are registered by unrecognized, self-constituted authorities. In some cases, hospitals have been able to use biologists and chemists with B.A. degrees to substitute for medical technologists. But lacking fully trained people, hospitals generally prefer to make use of certified laboratory assistants who are at least trained properly to do less complicated tests, or even to train unschooled laboratory helpers to do simple tests, rather than hire graduates of commercial laboratory schools. Some hospitals have reacted to personnel shortages by reducing or eliminating laboratory services requested by physicians for their office patients. This has forced some doctors to rely on their own less adequate testing facilities or on commercial laboratories having uncertain quality standards.[17] As a result, the level of health care received by their patients has suffered.

## *MDTA Programs for Training Health Manpower*

The supply of trained health manpower is produced by a variety of training facilities, including universities, junior colleges, public high schools, and vocational schools, training programs conducted by Federal, State, and local authorities, private business schools and schools for training in technical specialties, and on-the-job training on a formal or informal basis. The education and training of health service personnel, especially of those who require advanced education is a vast subject which cannot be examined in detail here. For purposes of the present study, the programs for training health personnel under the MDTA and related provisions are a particular focus of interest.

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[16] *Careers in the Medical Laboratory* (Muncie, Ind.: Registry of Medical Technologists, 1965), Fact Sheet.

[17] "Medical Lab Tests: Mistakes That Are Endangering Your Life," *McCalls,* May 1965.

Since 1962, MDTA training has become a significant factor in supplying health manpower, not only in projects training workers for semiskilled or subprofessional jobs, but also in refresher training projects for professional health workers. MDTA training projects approved between August 1962 and December 1966 provided training for a total of 63,000 men and women in health service occupations. Occupations such as licensed practical nurse and nurse aide ranked among the largest categories of all fields in which MDTA training was conducted. Approximately one-fourth of all the women trained on MDTA projects were in courses for training licensed practical nurses or nurse aides. As table 4 indicates, thousands of other men and women were trained in other health occupations, such as psychiatric aide, dental assistant, laboratory aide, surgical technician, home health attendant and in other specialties.

Most of the MDTA health occupation trainees have been enrolled in "institutional" projects which provide formal classroom instruction at health facilities and in schools. A growing number are being trained in on-the-job projects conducted at hospitals. Of particular interest is a contract for on-the-job training of roughly 4,000 hospital aides in various classifications being conducted in up to hundreds of hospitals, under the general direction of an affiliate of the American Hospital Association. This project is expected to provide guidelines for important advances in on-the-job training techniques. Many other contracts have been concluded with other specially qualified agencies concerned with relieving shortages of health manpower and making better use of available human resources. Typical of these is a project for training physically handicapped and other disadvantaged persons as certified laboratory assistants. Other experimental projects are constantly being undertaken.

Table 4. AUTHORIZED TRAINEES IN HEALTH OCCUPATIONS FUNDED UNDER THE MDTA, AUGUST 1962–DECEMBER 1966

| Occupation | Number |
|---|---|
| Total | 63, 036 |
| Professional nurses (refresher training) | 4, 723 |
| Licensed practical nurses | 20, 695 |
| Nurse aides/orderly and related occupations | 30, 028 |
| Nurse aides/orderlies | 27, 220 |
| Clinical assistants | 120 |
| Home attendants | 448 |
| Housekeepers (medical service) | 1, 654 |
| Ward maids | 378 |
| Other attendants | 208 |
| Specialized technical aides | 7, 123 |
| Dental technicians | 491 |
| Dentists' assistants | 765 |
| Medical laboratory assistants | 544 |
| Medical records aides | 151 |
| Medical technicians | 147 |
| Occupational therapy aides | 145 |
| Psychiatric aides | 2, 978 |
| Special diet workers | 440 |
| Surgical technicians | 925 |
| X-ray technicians | 132 |
| Others | 405 |
| Health clerical | 467 |
| Ward clerks | 320 |
| Secretaries and other | 147 |

SOURCE: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research.

One of the most significant developments in the evolution of MDTA programs for developing health manpower has been the growth of projects providing refresher training for professional staff nurses. Already several thousand professional nurses have been helped toward returning to active status through these MDTA refresher courses. Data on nurse licensure indicate that roughly 300,000 of the fully trained professional nurses who are currently either not working as nurses or not working at all still have their R.N. licenses. Many of them, mothers who left the nursing field to raise their families, would probably return to their profession if they could get convenient refresher training. MDTA programs for refresher training for nurses are therefore expected to expand. These programs can make a substantial contribution toward relieving the nurse shortage.

It seems likely that refresher and retraining courses for other groups of professional health workers could also contribute to relieving shortages. For example, according to one estimate, 7,000 trained and registered medical technologists, men and women, have left the laboratory in recent years. Many of these women, now homemakers whose children are grown, could be attracted back to work with the help of refresher courses. According to Mrs. Dallas Johnson, executive secretary, National Committee for Careers in Medical Technology, other persons with baccalaureate degrees in the sciences (such as chemistry, biology, physics) probably could be retrained as medical technologists within 12 to 18 months.

These are only a few examples of ways in which the MDTA programs now help or could help alleviate shortages of health manpower. However, it must be kept in mind that these programs represent only one phase of many efforts by both government and private agencies to deal with needs for trained health manpower.

## 2

# Technological Developments Affecting Manpower

What effects will technological developments have on the outlook for health manpower requirements? Can automation or other laborsaving technological advances help close the gap between supply and demand for health personnel? Whatever its possibilities may be for relieving manpower shortages, technological advances result in new kinds of jobs, and require changes in the content of existing jobs. These effects of technological change are particularly important in planning training projects and related manpower programs.

Technological change in general has been described as any change in the method of producing or distributing goods or services resulting from the direct application of scientific or engineering principles. All kinds of innovations, such as new methods of materials handling, the use of new and substitute products, and more efficient information handling and managerial control, as well as changes in production techniques and resources, may be included among technological developments.

Technological changes and related developments may have various effects, such as reducing costs, lowering requirements for manpower, capital equipment, or materials, providing convenience, comfort, and greater output or durability of goods and services. In this study, attention is focused on those technological developments likely to affect health manpower in the next decade—without regard to lifesaving, costsaving, or other effects, however important these may be in themselves. Manpower effects will take the form of reducing (or increasing) total man-hour requirements, changing the nature of skills required to carry out health service functions, or both.

Technological developments in the field of health service include not only those innovations that have originated in medicine and other branches of the health sciences, but also some that were first developed in industries such as manufacturing and trade. Some of the medical discoveries that have altered health technology were developed in research laboratories of medical centers; others have evolved in the course of daily patient care activity. These developments may affect health manpower requirements in various ways.

One way is by affecting the demand for use of health facilities. For example, a new drug, a new instrument, or a change in methods of patient care, may reduce the number of hospital admissions or the length of hospital stay needed to treat a particular disorder. But in other instances, new discoveries may bring into hospitals patients who were previously considered untreatable. Developments which prevent illness or disability, however, generally result in reducing requirements for health manpower. Some developments affect health manpower needs by altering the number of man-hours required per unit for performing specific activities in health facilities—for example, by reducing the man-hours needed to carryout a given number of identical laboratory tests, or to prepare and serve a given number of patient meals.

Estimating the effects of innovations on man-hour requirements for patient care during the next decade calls for a forecast of the pace at which they will spread—how long it will take from the time of their invention or discovery until they are adopted on a wide scale. Since the pace of spread varies widely among different kinds of technological advances, it is necessary to examine each category separately.

Among the basic questions involved in determining the manpower effects of technological changes in health service are those relating to the expected effects of medical research and development and its application. What important discoveries are on the way? How long will it take for them to be widely diffused in practice? Apart from new discoveries, how long will it take for already developed techniques to be applied to the full? These questions relate both to research results and the spread of new technology in protective or preventive medicine, and to innovations involving the care of patients already in need of health services. Sooner or later, medical advance and its spread through public and private programs of preventive medicine will affect the extent to which patient care facilities are used. The protective or preventive aspects especially involve expected trends in the growth of public health programs.

It is useful to start by looking at the kinds of patient care that have been required, and are likely to be required in the future, in patient care facilities. This requires consideration of data on illnesses and other conditions that give rise to patients' use of the facilities of the health service industry, especially the facilities of its mainstay—the hospital.

## *Effects of Medical Research and Public Health Programs*

The tremendous advances made in medical research and programs for protecting public health have lengthened the human lifespan greatly over the past few decades, but somehow they have not brought about significant changes in the pattern of illnesses or related causes of patient admissions to hospitals. Available evidence gives no reason to expect that medical research and public programs for preventing illness during the next decade will greatly reduce the volume or change the character of demand for patient care in health service establishments.

### *Recent Trends in Causes of Hospitalization*

The total number of hospital admissions and outpatient visits has increased steadily during recent years, mainly as a result of social and economic trends. The pattern of reasons for hospitalization of patients in short-term general hospitals has changed very little, however, at least in terms of the ranking of major groups of diseases or conditions. Data from a study sponsored by the American Medical Association, which was based on a representative sample of short-term general hospitals, shows remarkable stability in the pattern of causes of hospital admission, as shown over the 15-year period 1946–61.[1] These findings are summarized in table 5.

Throughout the 15 years, childbirth and related conditions accounted for about one-fifth

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[1] *Report of the Commission on the Cost of Medical Care,* vol. I (Chicago: American Medical Association. 1964), p. 146.

Table 5. Causes of Admissions to Short-Term General Hospitals, Study of 64 Hospitals, 1946, 1954, and 1961

[Percent]

| Cause of admission | 1946 | 1954 | 1961 |
|---|---|---|---|
| Total, all causes | 100.0 | 100.0 | 100.0 |
| Deliveries and complications of pregnancy, childbirth, and puerperium | 22.5 | 21.0 | 18.1 |
| Diseases of the respiratory system | 16.2 | 15.9 | 15.7 |
| Diseases of the digestive system | 12.6 | 13.8 | 14.0 |
| Injuries and adverse effects of chemicals and other causes | 9.5 | 9.7 | 10.2 |
| Diseases of the genito-urinary system | 8.1 | 7.9 | 8.7 |
| Diseases of the circulatory system | 5.5 | 7.4 | 7.8 |
| Neoplasms (tumors, cancers, etc.) | 5.8 | 5.9 | 6.1 |
| Diseases of the nervous system and sense organs | 2.9 | 3.5 | 4.0 |
| Diseases of bones and organs of movement | 1.9 | 2.7 | 3.1 |
| Allergenic, endocrine system, metabolic and nutritional diseases | 2.0 | 2.4 | 2.6 |
| Infective and parasitic diseases | 2.5 | 1.7 | 1.6 |
| Mental, psychoneurotic and personality disorders | 1.3 | 1.0 | 1.3 |
| Diagnosis not ascertained | 3.0 | .9 | .1 |
| All others | 6.2 | 6.2 | 6.7 |

Source: *Report of the Commission on the Cost of Medical Care*, vol. I (Chicago: American Medical Association, 1964), p. 146.

of the general hospital admissions; diseases of the respiratory, digestive, and genitourinary systems, together with injuries, accounted for another two-fifths. Conditions such as diseases of the circulatory system (heart disease, stroke, etc.), and cancer, which are leading causes of death and therefore quite naturally the subject of general concern, rank relatively low among causes of hospitalization by comparison with other conditions.

The continued importance of factors such as the birth rate and injuries (mostly from automobile, industrial, home accidents, and disasters), not strongly responsive to medical research or public health programs, is one reason to support the belief that general patterns of hospital admission will not be greatly affected by community health programs during the next decade. Whether other leading causes of hospitalization, such as diseases of the respiratory and digestive systems, will alter in importance remains to be seen. Some shifting will probably occur, perhaps relative declines in injuries, offset by relative increase in admissions among aged persons, but big changes are probably not in prospect between now and 1975. Slight changes probably will occur in some instances, as suggested by the fact that there were gains between 1946 and 1961 in the importance of diseases of the circulatory, nervous, and other systems, and declines in the importance of conditions such as infective and parasitic diseases. Innovations in preventive health technology may in the future produce some change in patterns of causes for hospitalization, but these changes in patterns will probably be slight.

The AMA-sponsored study we have been discussing also has provided information on trends in length of stays in general hospitals, which is an important element affecting the demand for patient care in health care establishments and their requirements for manpower. It was found that the average stay in surgical cases declined from 17.9 days in 1946 to 12.7 days in 1961, and of the cases that got medical treatment the stay fell from 12.8 in 1946 to 9.5 in 1961. The decline appeared to be due partly to increased application by physicians of the concept of early ambulation during patient recovery, partly to growing reliance on outpatient care and other forms of gradation in methods of patient care. It appears likely that in the future the average length of hospital stay will continue to decline, perhaps at a slower rate than in the recent past.

In view of the stability of the pattern of causes of hospitalization and length of hospital stays in recent years, and the prospect of only minor declines, can major changes be expected in demands for patient care as a result of the advance of medical research and public health programs? A brief review of the progress of medical care and public health programs helps to throw light on this question.

## *Medical Research*

The accomplishments of medical research in this century have been little short of miraculous. Advances of the past few years have included antibiotics, tranquilizers, vaccines for polio and measles, new advances in surgery, and new means of birth control. Many new medications of all kinds have been developed; 3 out of 4 medical prescriptions being written today were unheard of 25 years ago.

Health research activity has been expanding in the United States at a phenomenal rate during the last decade, largely as a result of financial support by the Federal government. In 1954, total public and private expenditures of medical research were estimated at about a quarter of a billion dollars; about 12,000 medical and other scientists were employed full or part time. By 1960, only 6 years later, expenditures were roughly three-quarters of a billion, and 40,000 research workers were employed. It is expected that by 1970, national medical research expenditures may reach $3 billion and nearly 80,000 professional workers will be needed.[2]

There seems to be no really satisfactory method of summarizing the direction or pattern that health research is taking. The dollar amounts made available to outside scientific investigators in fiscal year 1964 by the National Institutes of Health, give only a suggestion of the breadth and intensity of campaigns covering a broad front:[3]

| *Health field* | *Amount (millions)* |
|---|---|
| Mental health | $135.4 |
| General medical science | 99.2 |
| Heart | 95.3 |
| Arthritis and metabolic | 85.4 |
| Cancer | 66.8 |
| Neurological diseases and blindness | 64.2 |
| Allergy and infectious diseases | 46.0 |
| Child health and human development | 27.0 |
| Dental | 13.8 |

Besides these funds for grants, other work in many areas is being supported by programs budgeted separately within the Institutes of Health and other branches of the U.S. Public Health Service. Many more projects in medical research are being carried on outside the Federal Government by State and local governments and by private groups, using their own sources of financing.

Despite the fact that so much research is being conducted in so many fields, there is no way of knowing where important results can be expected in the near future in the form of specific developments for preventing or curing disease. Specialists in particular fields tend to be reluctant to be quoted on forecasts of progress, especially how long it may take to achieve successful results. One can only guess at forthcoming accomplishments in medical research, using informed conjectural comments by medical specialists and occasional items in the popular press. Of course, all such conjectures are of limited value and are likely to be contradicted by unexpected standstills, or by breakthroughs, in research.

In cancer research, particular attention is being focused on research concerning relationships between viruses and malignancy. It is now believed many separate and combined factors contribute toward the many different forms cancer takes; research is proceeding along several lines. Hope is expressed for finding a cure for leukemia within the next decade, and for means of preventing and curing some other forms of cancer, but few informed observers believe that progress toward cure or prevention will be sufficient by 1975 to reduce the cancer toll substantially.

Cardiovascular disorders are another area of research on which much attention is centered. It is considered likely that by 1975 there will be much greater knowledge of the effects of cholesterol, sugar, and other dietary factors on heart disease, and that gains will be made in better understanding of hypertension. There are general expectations that progress will continue in the development of drugs to treat these conditions. Progress in the improvement of surgical techniques for treating various forms of heart disease is likely to continue. Some observers expect that the near future will also bring further gains in knowledge of how to prevent strokes, on which some progress has already been made.

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[2] *Manpower For Medical Research Requirements and Resources, 1965–70* (Washington: Department of Health, Education, and Welfare, Public Health Service, 1963), p. 14.

[3] *1964 Annual Report* (Washington: U.S. Department of Health, Education, and Welfare, 1964), p. 231.

The research in several other areas appears to offer great promise. Study of drugs for use in mental disorders is considered likely to continue to produce new and improved means of treating the mentally ill and retarded. Progress is expected in the prevention and cure of the few major infectious disorders which are still serious causes of disability; medical research specialists appear to be confident that measures for preventing German measles will soon be generally available and that protection against hepatitis may be found in the next few years. However, it is widely believed that it may take many years before effective means of preventing the common cold is found, despite the fact that much research on this problem is going on.

Progress is expected in the development of drugs to aid in the treatment of arthritis, enzyme deficiencies, and obesity. There is general expectation that gains will also be made in the field of tissue transplants and in the implanting of artificial internal organs and parts, as well as in improving artificial limbs.

The foregoing observations scarcely touch the surface of the enormous scope of medical research, and merely suggest some general expectations. What do these expectations imply in regard to demands for patient care, assuming a moderately optimistic outcome for ongoing research efforts during the next 10 years? It is obvious that even moderate success in these research activities would eventually lengthen lives, diminish pain, and increase the happiness of millions of people. But at the same time, it seems reasonable to expect that progress in preventive health technology will not be sufficiently rapid to alter greatly the kinds of health services demanded in patient care facilities in the next decade. Much will depend, of course, on the specific nature of the new discoveries or other developments that will occur. But considering the time needed for diffusion of the use of new techniques, equipment, or medications, moderate success in research will probably not greatly reduce the volume or change the pattern of demand for manpower in health service establishments during the next 10 years.

### *Public Health Programs*

Only to a limited extent are hospitals or other patient care health service facilities (as defined for purposes of this study) engaged in the prevention of illness. A major share of the preventive and related efforts toward protecting the health of the population at large is made by governmental and other community agencies that carry out regulatory, information, disease detection, and related health fostering activities. Among these, the well-established programs include: Protecting the public against contaminated foods, poisonous drugs, and other harmful materials; controlling the spread of communicable diseases; fluoridation of water supplies for protection against dental caries; occupational disease and accident prevention programs; promoting infant health; examining children and the population in general to detect visual deficiencies, tuberculosis, diabetes, veneral disease, and other disorders; vaccinating schoolchildren and others against smallpox, diphtheria, polio, influenza, measles, and other diseases; promoting the health of the population generally through the issuing of information on personal hygiene. Expansion of such programs depends partly on the results of continuing research toward finding solutions to health problems, but perhaps even more on the availability of funds to spread the application of known techniques.

***Environmental Protections.*** Leaders in the field of community health increasingly emphasize the threat to health of many physical and social factors in our environment. Dr. George James, former Commissioner of Health of the City of New York, has said:

> Our society is now creating our most significant health difficulties. As a matter of fact most of the major health problems awaiting our attention appear to be man made. As man has conquered infectious disease, perhaps more through an improvement in his standard of living than specific therapy, he must pay the price for this standard of living. The background of the health problems of our current and

> future age is increasingly made up of our growing cigarette-smoking habituations, our alcohol-centered socializations, our high-fat high-calorie routine diet, our swift and dangerous motorcars, our smoke-belching factories, our heavily polluted waterways, our pesticide-dependent agriculture and our steadily increasing exposure to ionizing radiation.[4]

Some of these problems have become the target of new public health measures during the last 5 years, including programs for control of the pollution of air and water, warnings to the public of the dangers of cigarettes and high-calorie diets, control in the use of pesticides. Continuation and strengthening of these environmental programs and development of new activities for protection of the public health are certainly to be expected.

***Diagnostic Programs.*** Along with broadening of public health programs and increasing stress on providing health care to individuals has come a shift in emphasis among many leaders of the health profession toward a patient-centered, rather than a disease-centered approach to the problems of public health. This would involve going beyond the ailments that bring people to a public health facility, to look at their total health needs. One implication of this concept is that there is need for a great expansion in programs for diagnostic examinations, to cover the entire population, going well beyond what are now the modest screening programs currently in effect in some cities.

Modern technology has an important role to play as this trend develops, by providing new instruments and increased convenience and reduced costs of examining patients and keeping patient records. Health planners are studying possibilities of regional and local programs for large scale diagnostic screening of the whole population, utilizing computer-based central storage of medical records of individuals, allowing for access and retrieval of patient data by all hospitals and doctors in the area.[5] Some plans feature mass physical examinations in which, as a preliminary to physical examination and health counseling by a physician, there would be administered to a patient a battery of at least 20 laboratory health tests in a period of 2 hours using automated techniques. The results would be analyzed by a computer and a report printed for the physician, indicating abnormal test values and abnormal symptom complexes that require special attention. The mass routine procedure would cost an estimated $25 to $30 and replace procedures now costing $100 to $200 and requiring 1 to 2 days.[6]

***Informational Uses of Electronic Computers.*** Success in community health depends partly on the effectiveness of community systems for collecting and analyzing health data of the widest variety, such as data resulting from the operation of public health agencies and data from special studies. Systems are now being devised to harness the electronic computer to the collection and analysis needs of statewide and nationwide public health administration agencies. Considerable attention has been given to a system of this kind that is being developed for states.[7] (See chart 5.)

Use of the computer in carrying out public health programs will parallel the already expanding reliance on the computer in statistical and medical research programs related to public health. Statistical data on health trends among the population that result as a byproduct of public health programs can furnish a valuable resource—not only for research, but also for providing immediate help to physicians as they treat illness or try to prevent its spread.

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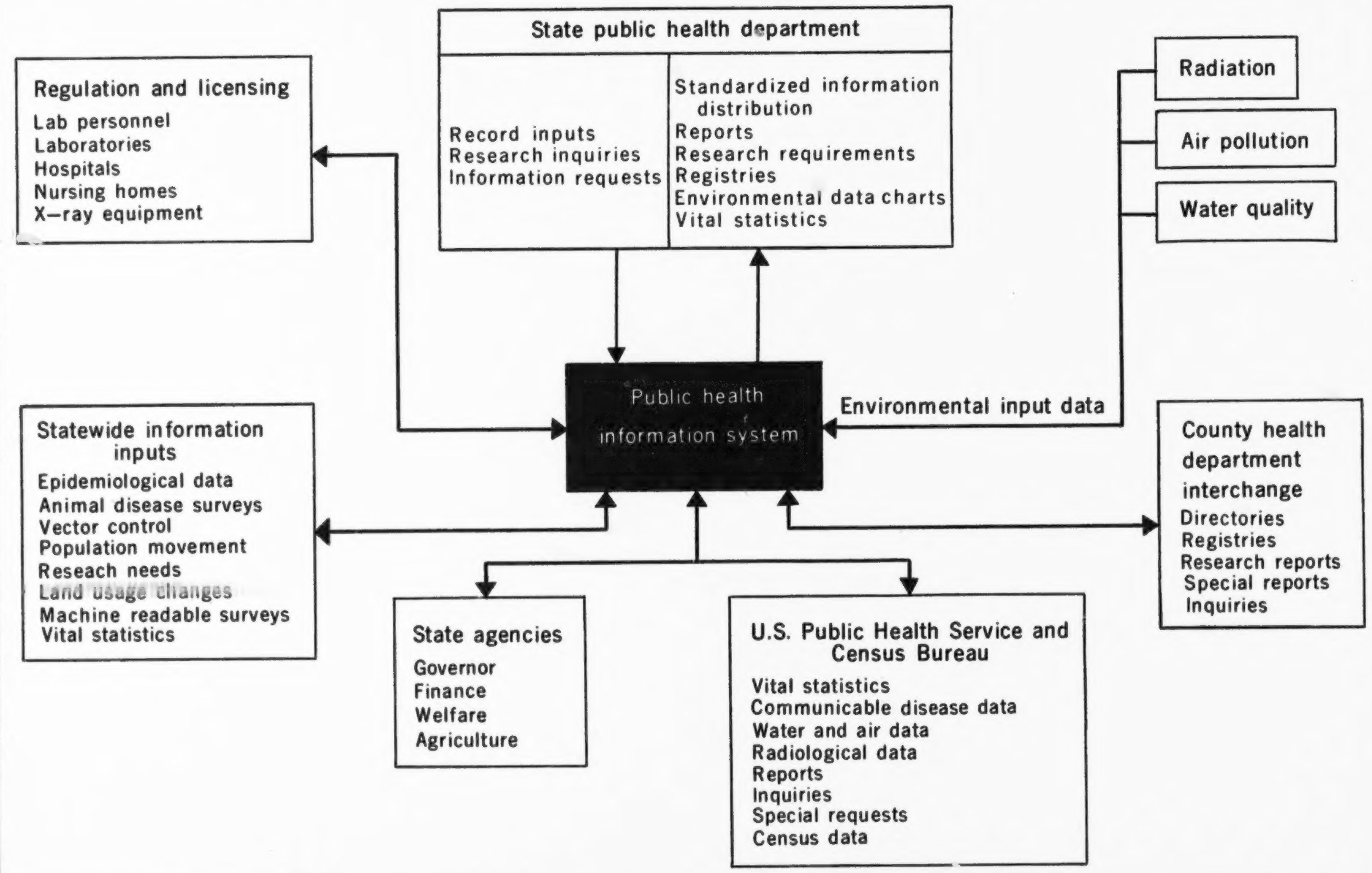
[4] Address by Dr. George James, Commissioner of Health, New York City, to the Eastern States Health Conference, New York Academy of Medicine, April 20, 1964.

[5] Statement and memorandum by Dr. James W. Dow and other staff of the National Institutes of Health, July 16, 1965.

[6] Letter by Dr. Richard A. Prindle, U.S. Public Health Service, to the National Commission on Technology, Automation, and Economic Progress, June 7, 1965.

[7] *Proposal to Design A Public Health Information System* (Sunnyvale, Calif.: Lockheed Missiles & Space Co., November 13, 1964).

Chart 5. Total information system schematic
A State public health department


State public health department
Record inputs
Research inquiries
Information requests
Standardized information distribution
Reports
Research requirements
Registries
Environmental data charts
Vital statistics
Regulation and licensing
Lab personnel
Laboratories
Hospitals
Nursing homes
X–ray equipment
Radiation
Air pollution
Water quality
Public health information system
Environmental input data
Statewide information inputs
Epidemiological data
Animal disease surveys
Vector control
Population movement
Reseach needs
Land usage changes
Machine readable surveys
Vital statistics
County health department interchange
Directories
Registries
Research reports
Special reports
Inquiries
State agencies
Governor
Finance
Welfare
Agriculture
U.S. Public Health Service and Census Bureau
Vital statistics
Communicable disease data
Water and air data
Radiological data
Reports
Inquiries
Special requests
Census data

Source: U.S. Department of Labor: Manpower Administration; Office of Manpower Policy, Evaluation, and Research, based on data from the California Department of Public Health.

Another use of the computer for furtherance of both medical research and patient care, somewhat related to its use in processing health statistics, is the establishment of computer-based networks of information on significant developments in biomedical science. In 1963, the National Library of Medicine activated the Medical Literature Analysis and Retrieval System (MEDLARS), producing a monthly list of 14,000 articles from the world's biomedical literature, the "Index Medicus," using the computer. It has been estimated that this is five times as large an index system as had previously been available (in a project antedating the computer operated by the American Medical Association). Work is now proceeding on an International Nursing Index. It is planned to extend such programs to include publication of specialized bibliographies, translation, abstracts, and similar services related to the needs of health sciences.

Computer systems are being developed linking the medical libraries of major universities by teletype wires to provide literature searches of all the libraries' materials instantaneously, on demand. It is expected that eventually international networks of information using computers will be established to give instantaneous service to specialists performing medical research, public health and patient care activities, furnishing information not only from medical literature, but also statistics on current and past trends among the population in relation to specific health subjects. Substantial assistance toward community health goals, in this country and in the world may be expected from such developments.

***Outlook for the Effects of Research and Preventive Programs.*** Many of the most dramatic of the expanding programs for community health care are being aimed at major threats to life. President Johnson has outlined in many public statements his intentions to increase allocations of money and manpower to a number of critical programs. He has stated the following as some of the goals of his administration:[5]

1. An increase in life expectancy from 70 to 75 years.
2. Reduction of infant mortality from 25 to 15 per thousand.
3. Virtual elimination of tuberculosis, measles, and whooping cough, as well as polio, diphtheria, and typhoid fever.
4. Reduction of one-fifth in the incidence of heart disease, cancer, and stroke, which now account for 70 percent of all the deaths in the United States.

Apart from the programs for dealing with the scourges indicated by the President, there is evident a general determination to broaden the protection of the public from hazards in the air we breathe, the water we drink, the food we eat, and other environmental hazards. It is reasonable to expect that substantial progress will be made eventually in reducing many of these present dangers to health, both from research programs and from the extension of public health activities. But it is difficult to venture a guess on the pace of the expected progress and its effect on the volume and pattern of demand for services from hospitals and other patient care facilities.

For the present, therefore, it seems necessary to omit a forecast of the effects of research and public health programs on the demand for health manpower during the next 10 years. In any case, available evidence suggests that progress will be slow.

Among the many difficulties that would be involved in such a forecast is the fact that some applications of medical research and public health protection programs reduce demands for patient care of certain kinds, but other applications may bring about increased demands for patient care services. To illustrate, developments in preventive medicine such as the discovery and distribution of polio vaccine have greatly shrunk demands for hospital bed occupancy; however, developments such as the success of tuberculosis detection campaigns have been bringing to hospital wards patients who might never have gotten there otherwise. For the present, perhaps it is reasonable to assume, as suggested by the data in table 5, that in any case the extent and causes of disability among the population will not change sufficiently in the next decade to have much effect on the volume and kinds of manpower required to provide patient care.

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[5] Remarks of the President at the signing of the Community Health Services Extension Act, August 5, 1965.

## Technological Developments in Patient Care Facilities

The effects on manpower requirements of the technological developments being adopted for use in facilities providing direct patient care are somewhat easier to evaluate than those attributable to advances in preventive medicine. The important technological developments in health service facilities include both clinical and nonclinical innovations. They assume various forms, and can be grouped into categories in more than one way. Popular discussions devote much attention to highly technical innovations in the field of "medical electronics," as well as to more homely developments such as the use of disposable supplies made of paper and plastic materials to replace items that have to be cleaned and sterilized. From the standpoint of appraising manpower implications it seems most useful to consider the various kinds of technological and related developments taking place in health care facilities in terms of these four broad functional categories:

1. Developments in diagnosis and patient care,
2. Supplies and services in health facilities,
3. Hospital information processing, and
4. Organization and design of health facilities.

### Developments in Diagnosis and Patient Care

Technological developments in the fields of diagnosis of illness and care of patients cover a very broad range. They may be summarized in three groups: (1) Diagnostic, testing, and monitoring equipment—laboratory instruments, X-ray and related equipment, computers, and equipment for patient monitoring; (2) surgical equipment and procedures; (3) therapeutic techniques and materials.

***Diagnostic, Testing, and Monitoring Equipment.*** In the clinical laboratory the development and spread of automatic equipment for chemical and other tests of body fluids and tissues has proceeded rapidly. So much of the work previously done by manual methods is now handled routinely by mechanical devices and instruments that "automation of the laboratory" is widely considered to be well-advanced.

Exhibit 2 lists automatic and other advanced electronic devices currently to be found in research and clinical laboratories. Most of these have been developed in the last 10 to 15 years; in fact some are not yet widely in use in hospitals or other clinical laboratories, being limited mainly to research labs. It will not be possible here to discuss more than a few of these instruments.

*The development of the automatic chemical analyzer represents the greatest single contribution, thus far, toward automation of the laboratory.* Most of the work in a typical clinical laboratory consists of repeated performance of a small number of routine tests, many of which can now be done on a few automated devices. Two analyses (for glucose and urea nitrogen) account for somewhere between 25 and 35 percent of all tests in the average lab; 10 types of tests can account for 70 to 80 percent of the entire workload.

In many small hospitals automatic devices are generally absent, but in most medium-size or large hospitals, it has been estimated that in 1965 perhaps 25 to 50 percent of the laboratory workload had been turned over to automatic instrument and that in 10 years this figure will climb to 75 percent.

The spread of the automatic chemical analyzer is largely responsible for the spread of automation in the laboratory. In 1963, nearly 5,000 automatic chemical analyzers were in clinical labs. Most U.S. hospitals with over 200 beds have one or more of these instruments.

The device consists basically of seven components: A sample turntable, a proportioning pump, a mixing coil, a dialyzer, a heating bath, a colorimeter, and a recorder. The operations it performs may be summarized as follows: The sample turntable is loaded with a large number

### Exhibit 2—Applications of Electronic Instruments in Medical Laboratories [9]

*Analysis of biochemical constituents*

Colorimeters, automatic chemical analyzers
Spectrophotometers for visible ultraviolet, infrared spectroscopy and fluorescence
Emission spectrometers, flame photometer, emission spectrograph
Chromatographs (paper, gel, starch)
Gas chromatography, amino acid analyzers
Gas analyzers for oxygen, carbon dioxide, nitrogen, carbon monoxide, helium and radioactive rare gases (krypton, agron)

*Analysis of physical and chemical properties*

pH meters
Electrophoretic apparatus
Nuclear magnetic resonance detector
Electric conductivity meters
Viscosimeters
Osmometers
Mass spectrometer
Thermal conductivity meters
Paramagnetic oxygen analyzers
Ionization detectors
Oxygen electrodes, blood-gas analyzers

*Analysis of physical properties*

Densitometers
Light amplifiers
Electron microscopes
Ultraviolet microscopes
Electronic micrometry
Electronic scanners, cell counting, cytology
Isotope detectors, scalers, counters, integrators, plotters

*Miscellaneous laboratory apparatus*

Fraction collectors
Deionization apparatus
Centrifuges, ultracentrifuges
Titration apparatus
Ultrasonic cleaning equipment
Automatic equipment for staining of pathologic specimens

of specimens, which are pumped into the system of analysis provided by the other components and subjected to specific analytical operations, sample by sample. Individual samples are separated by air bubbles. The final results of tests are entered on a strip chart shown by the recorder.

Procedures have been worked out for determining at least 18 different components in blood and urine on the automatic chemical analyzer. Other fluids can also be tested on the instrument, and some laboratory technologists have extended its versatility over a wide range of additional clinical tests. For most tests, accuracy of the automatic chemical analyzer is at least equivalent to that of manual methods.

The early automatic chemical analyzer permitted substantial reductions in time and costs to carry out tests (cost of a glucose test was reduced from a range of 50 to 75 cents by manual methods to 20 to 30 cents on the autoanalyzer). Even further savings result from use of an improved model of the automatic chemical analyzer announced in 1963. This instrument has eight channels, allowing for tests measuring eight different chemical components at once on the same specimen. In an 8-hour day it can run 960 individual tests, the equivalent of what an average technician is expected to do in 3 weeks. (See drawing.)

Many other significant laborsaving developments in automated laboratory equipment have been introduced. These include the blood-gas analyzer, the automatic chloride titrator, the atomic absorption spectrophotometer, the Coulter automatic blood cell counter, automatic pipettes, cytoanalyzers, and various others. Each of these makes it possible to carry out tests in a fraction of the time required by manual methods, without loss of accuracy (and sometimes with gains in accuracy).

Among the valuable features of these instruments is the fact that many of them produce a graphic or tabular permanent record of test results which saves labor, reduces opportunities for error, and otherwise increases their clinical value. Moreover, many new instruments are adaptable for use with digital electronic computers to carry out calculations that otherwise have to be done by laboratory technicians using conventional methods. The physicians who order examinations need test results in quantitative terms that are not derived automatically in standard laboratory procedures. In the absence of computers, this often requires calculations which would take up much of the time of technicians.

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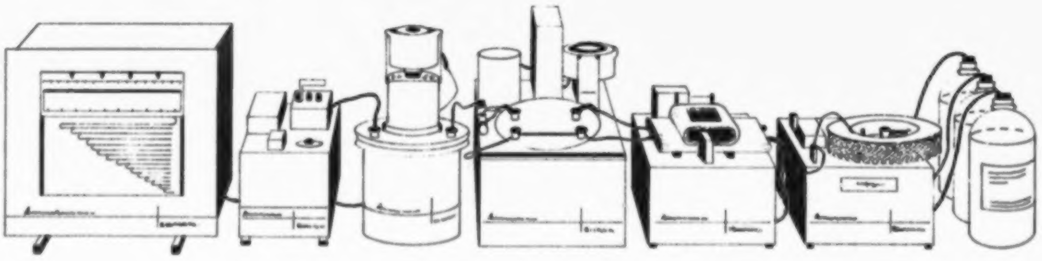
[9] Source: "Impact of Electronics on Medicine," *Postgraduate Medicine*, October 1964.

Clinical laboratory specialists expect that in the future it will be possible to extend greatly the mechanization of laboratory tests. Apparatus is being developed, for example, to carry out continuous monitoring of the blood and other body fluids of patients during surgery or post-surgical recovery periods. Indwelling catheters or detectors connected to the patient's body would monitor the patient's body chemistry continuously and set off alarms to warn the medical staff instantly if dangerous trends develop.[10]

It is generally believed by informed observers that recent sharp growth in demands for clinical laboratory tests will continue, and perhaps accelerate. Consequently, the laborsaving effects of automated equipment have offset only partially the continuing shortage of medical technologists. One team of experts has said: "Automation can handle the repetitive 'routine' tests which account for 90 percent of laboratory load and free our technical staff for new and important tests and more difficult patient problems." [11] It is for this reason, and the greatly increased capacity for testing provided by automation in the laboratory, that the new equipment is generally welcomed. Since the demand for laboratory services will continue to rise, the need for highly trained technologists will not be reduced.

*Important advances are being made in X-ray and fluoroscopic equipment.* In most hospitals and offices of physicians and dentists, X-ray and fluoroscopic equipment represents a substantial investment and is constantly in use as a basic tool in the diagnostic process. Fundamentally, the same type of X-ray equipment has been used for diagnosis by radiologists and other physicians over many years, but developments now under-



*This automatic chemical analyzer includes six components. They are, from left to right: Recorder, dual beam flow colorimeter, heating bath, dialyzer in constant temperature bath, pump, sample turntable.*

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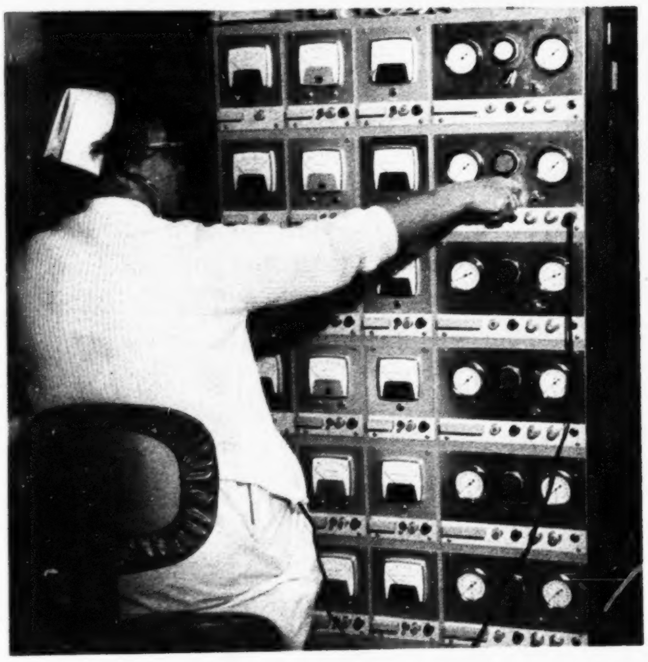
[10] The discussion of clinical laboratory equipment in this section was based mainly on "Instruments for Clinical Chemistry Labs," *Chemical and Engineering News*, December 9 and 16, 1963.

[11] Philip H. Geisler and George E. Williams, "Automation in the Clinical Laboratory," *Hospital Topics*, February 1963.



*The patient's blood pressure can be checked by stethoscope at the central nursing station.*

way are likely to result in adoption of a much broader range of advanced equipment.

According to one specialist, recent technical innovations may make standard fluoroscopy equipment obsolete. New electronic devices now being installed in hospitals magnify very small radiations and achieve brighter images without increasing radiation risk to the patient or fluoroscopist. Some types of presently available new equipment routinely record fluoroscopy on moving picture film; the cineX-rays can then be viewed by physicians in slow motion, or a frame at a time. Such images can be transmitted over wires, and make it possible for rural or other remote hospitals to have the advantage of interpretation by expert roentgenologists located in distant cities.[12]

Feasibility of other advances in using basic X-ray equipment has been demonstrated at several medical research centers. One innovation makes possible optical scanning of X-ray films and conversion of images into a digital form which a computer can then store and process. The procedure provides the physician with a valuable aid to diagnosis. "The device measures the image density of the film, spot by spot, translating each spot into a numerical code; . . . It then converts the numbers back into light intensities on a display screen, thereby sharpening contrast and revealing details that might otherwise be lost completely." [13]

Other extensions of X-ray techniques include various adaptations of television, and production of three dimensional images. Modes of visualization based on principles other than X-ray are being adopted in the radiology department of some large hospitals. One of these modes is ultrasonography, which avoids risk of radiation damage, provides visualization of soft tissue not shown by X-rays, and has other advantages.[14]

Use of radioisotopes for diagnosis of disease dates back at least a decade; new developments make possible photoscanning of tissues attacked by disease and the production of an image on special paper which helps towards diagnosis. According to results of a survey conducted by a trade magazine, radioisotope scanners and monitors have been acquired by a substantial number of hospitals.[15]

Still other related techniques are under development, and some are already in clinical use. One, called "Thermovision," involves the application of television techniques to medical thermography, allowing doctors to get an immediate look at heat patterns in the body. The new process, developed in Sweden, helps doctors observe disease activity in rheumatoid arthritis, local infections, and other conditions and can speed diagnosis.[16]

These and related developments are likely to result in some laborsavings in the radiology departments of hospitals and in physicians' and dentists' offices, and to have other manpower implications, apart from their enormous value in improving the quality of patient care. They will enable technicians to work more quickly and surely and help physicians to arrive at better diagnoses more rapidly. The result is likely to be a demand for more highly trained technicians in the X-ray department than have been needed up to now.

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[12] Mark S. Blumberg, "Electronics Can Expand X-ray Capability," *Modern Hospital*, 1964.

[13] John E. Pfeiffer, "How Technology Advances the Art of Medicine," *Think*, July-August, 1964.

[14] William E. Bushor, "Medical Electronics," *Electronics* (5-part article, January 20, 1961 through January 19, 1962).

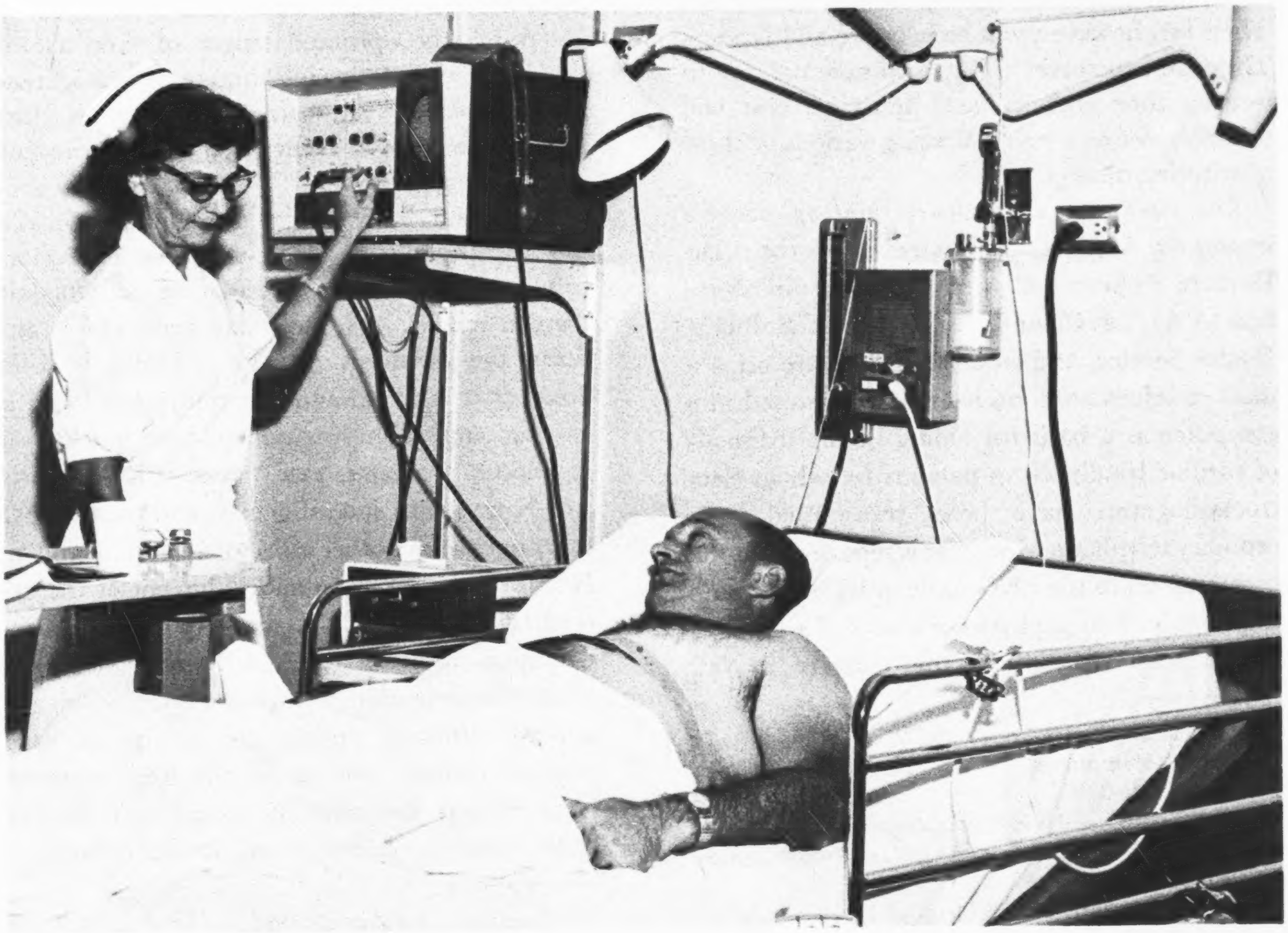
[15] "Survey Shows Widespread Acceptance of Electronic Instruments in U.S. Hospitals," *Modern Hospital*, November 1961.

[16] Robert Skole, "Thermovision: Heat Pictures on an Oscilloscope Screen," *Electronics*, July 26, 1965.

*New testing and patient monitoring instruments based on the electrocardiograph principle are being developed and adopted.* Many new instruments being applied to the diagnosis of illness, and to testing and monitoring the patient's condition, are extensions of the principle represented by the electrocardiograph (EKG or ECG) invented in 1903. Perfected in 1935 in the form of a portable device, the EKG instrument is available in practically every hospital and physician's office to measure contraction and relaxation of the heart muscle and record these events on paper. Since 1935, similar devices have been developed to measure other bodily functions, such as the electroencephelograph (EEG), electromyograph (EMG), and other instruments.

Further extension of these principles led to the incorporation of electronic instruments into "total monitoring systems" (often mounted in consoles for use in operating rooms or at the bedside of patients) for observing, recording, and signaling measurements of numerous body functions. In addition to providing continuous recording of heart activity, these bedside systems may currently gage temperature, blood pressure, respiration rate, and other measurements.

Acceptance of the value of these multipurpose instruments during surgery is general. Opinions are divided, however, on whether "total monitoring systems" are useful in patient care units. Much has been written about the potentiality for use of these systems as a way of saving on the need for professional nursing time—in



*Electronic body function recorders are attached to the patient.*

some quarters they are considered to promise substantial aid in alleviating the nursing shortage.[17] The more conservative view is that these systems, or elements of them, will some day provide a useful adjunct in many patient care situations, but will not save on requirements for nurse man-hours. Heart specialists of the U.S. Public Health Service urge the use of a cardiac monitor (which provides continuous EKG measurements) in specialized intensive care units for coronary patients, but call for the nursing staff, rather than electronic monitoring, to take measurements of other body functions such as blood pressure and pulse.[18] A staff member at the Clinical Center of the National Institutes of Health says that for patients not under anesthesia even EKG monitoring is rarely needed on a continuous basis, and that equipment for bedside monitoring of general bodily functions is not trustworthy and otherwise not yet well enough designed to be feasible for use. He says that "Monitoring systems will be used in the future. Their use, however, will be selective and limited. They are expensive. They will save nothing in nursing time and, in fact, personnel cost will probably rise as a result of using various of these monitoring devices." [19]

*The electronic computer is making possible important advances in clinical medicine.* Dr. Herbert Pipberger of the Veterans Administration (VA), Dr. Cesar Caceres, of the U.S. Public Health Service, and other physicians are using a mass of information on heart disease stored in a computer as a basis for aiding in the diagnosis of cardiac conditions in patients for whom electrocardiograms have been transmitted over ordinary telephone wires. It is reported that the computer reads the EKG more quickly and more thoroughly than a physician can. "In cases of biventricular hypertrophy (thickening of the wall of the ventricles), for instance, doctors make a correct diagnosis 24 percent of the time. The machine scores 94 percent. Doctors can detect evidence of an old heart attack 7 of 10 times. The VA computer hasn't missed yet." [20]

Physicians using computers are studying various heart conditions, including faulty heart valves, misplaced blood vessels, and other congenital defects which can be repaired surgically. A group of doctors at a Salt Lake City hospital have developed a method of computer diagnosis of these defects based on a statistical application of Bayes' Theorem on probability of causes. It is reported that results of the computer diagnosis of heart conditions were determined to be highly accurate by comparison with the performance of skilled cardiologists, and better than the record made by physicians who were not heart specialists.[21]

In another application of the computer, at the Texas Institute for Rehabilitation and Research, statistical correlation techniques were used to determine the optimum length of time a cast should be worn following surgery for straightening the spine.[22] At Kalamazoo's Borgess Hospital a computer is being used to help prevent embolisms after surgery.

These and many similar developments in the use of computers to aid in diagnosis have contributed toward some speculation on whether these machines will some day completely routinize the diagnosis function. There is little doubt that right now the computer can bring a vast amount of information to bear quickly on diagnostic problems, can "read" EKG reports and X-rays with special acuity, and can rapidly carry out various other tasks to *help* in diagnosis. However, the intuition and judgment of the attending physician will continue to make his participation indispensable. As physicians learn to use the computer in widening applications, its potential toward raising the quality of care patients receive, and saving the time required of physicians and other personnel will become better understood, but so will its limitations.

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[17] *Conversion Prospects of the Defense Electronics Industry* (Hempstead, N.Y.: Hofstra University, 1965), pp. 320–332.

[18] *Coronary Care Units* (Washington: U.S. Department of Health, Education, and Welfare, Public Health Service, 1964), p. 30.

[19] Robert M. Farrier, "Problems of Electronic Monitoring," *Hospitals, Journal of the American Hospital Association*, April 1, 1963.

[20] *Newsweek*, January 25, 1965, p. 75.

[21] *New York Times*, May 28, 1963.

[22] *New York Times*, July 21, 1963.

***Surgical Equipment and Procedures.*** Many advances have been made in surgery during the past few years, requiring many new kinds of equipment and human skills. An achievement which has helped toward enormous progress in cardiac surgery has been the development of the heart-lung machine. This artificial heart and lung is both a pump and a blood aerator; it adds oxygen to the blood and removes carbon dioxide from it. It permits the patient's blood flow during surgery to bypass his own heart and lungs so that the latter can be operated on to repair defects or malformations. Using it, surgeons such as Dr. Michael De Bakey of Baylor University and Dr. Albert Starr of the University of Oregon have developed procedures for reaming clogged arteries, repairing damaged hearts, and installing artificial valves and other plastic body parts.

Synthetic body parts are now being implanted in many organs of the body, providing relief against desperate illnesses, and lengthening the lives of thousands of people. Even the brain is amenable to such surgery and implantation of artificial devices. Only 10 years ago, a child born with the condition known as hydrocephalus (water on the brain) was doomed to mental retardation or early death. Today, more than 80,000 youngsters with this condition have been helped by an implanted silastic tube.[23] Dr. De Bakey is confident that within a few years a complete mechanism will be developed and successfully implanted in humans, replacing defective hearts.[24] In 1966, both he and Dr. Adrian Kantrowitz, of Maimonides Hospital, Brooklyn, succeeded in installing artificial heart pumps which took over part of the heart's load.

Limited advances have also been made in transplantation of organs, such as bones, skin, and the cornea of the eye. Experimentation toward replacement of defective human kidneys with transplanted organs from donors or bodies of deceased persons has had success in a few cases, and some specialists hope that transplants will soon be done well enough to become the preferred method of treating kidney diseases.

Meanwhile, artificial kidney machines are used in treating chronic kidney failure, but these machines are available only at a few kidney dialysis centers, and help but a small number of the many thousands of persons suffering from incurable kidney disease.

The machines are used to cleanse the blood of afflicted patients, who report for care once or twice weekly. The patient's blood supply moves between his body and the machine through two small plastic tubes permanently attached to his forearm. This treatment has saved many lives and has even enabled some kidney disease victims to continue working. In many cases, however, the results have represented only partial success in restoring the patient's capacity for functioning.

According to the National Kidney Foundation, about 400 hospitals have these machines but most of them use them only for relief in acute kidney cases.[25] It has been estimated that every year 3,600 victims of chronic kidney disease die whose lives could be saved by the machines. Currently fewer than 60 hospitals in the United States provide kidney dialysis care to chronic sufferers. In many of them capacity is limited, and patients must be selected among many applicants for treatment.

One reason the equipment is not generally used for chronic cases is that kidney disease specialists differ regarding its effectiveness. But in the opinion of some specialists it is the shortage of personnel qualified to give the treatment, as well as the high cost of the treatment, that holds back its spread. The cost of care per patient at a dialysis center is estimated at $10,000 yearly. Enough centers to take care of most chronic kidney sufferers in the country could ultimately require billions of dollars, as well as thousands of health workers, because of the cumulative effects. To care for 30 patients at one center, a full-time staff of 1 doctor and perhaps 7 technicians and 10 nurses would be needed.

Many specialists are urging widespread establishment of such centers, saying that withholding of a beneficial medical discovery from general availability is unprecedented.[26] Others believe that the artificial kidney machine has not yet brought sufficient help to patients to justify expense of the operation of dialysis centers. They are more inclined to rely on hope that techniques for transplants of human kidneys will improve. Meanwhile, research work is proceeding aimed at developing home dialysis machines which would substantially reduce the cost of treatment. If existing models of such machines are improved and adopted on a wide scale, the efforts of many physicians, nurses, and technicians at hospitals and medical centers would be needed to prepare, instruct, and otherwise treat patients using them.

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[23] *Time Magazine,* January 1, 1965.

[24] *Parade,* May 16, 1965.

[25] "Does Your Hospital Belong in U.S. Network of Kidney Dialysis Centers?" *Modern Hospital,* January 1965.

Development of artificial aids to body function has achieved success in various other directions. One of the most significant is the surgically implanted pacemaker, a tiny battery-operated device which is installed under the skin in the abdominal area, with electrodes embedded in the heart muscle. This unit paces the heartbeat of victims of heart block, a condition in which the heart beats too slowly or undependably. Present models of implanted pacemakers have inadequacies that many specialists believe will be overcome in time. A major shortcoming is that the batteries run out and must be replaced in a repeated surgical procedure. It is expected that ultimately methods will be found of utilizing electricity generated within the body, or perhaps atomic fuel, to power the implanted pacemakers.

Other electronic devices are being used in surgery in various other ways—to restore hearing, to make possible new ways of speaking after surgical removal of the larynx, to enable artificial arms or hands to function usefully. It is reported that Russian physicians have developed an artificial arm with an electronic hand that opens and closes, reversing action almost instantaneously, capable of a maximum force of 33 pounds, and activated by electrodes fastened to body muscles.[27] Progress along these same lines has also been reported from medical centers in the United States.

Among the more spectacular aspects of the use of electronics in surgery have been the application of extreme heat, in the form of laser beams, and extreme cold, using cryoprobes. Lasers have been used successfully in eye surgery. Cyrosurgery has made possible substantial advances in the treatment of Parkinson's disease and other disorders.

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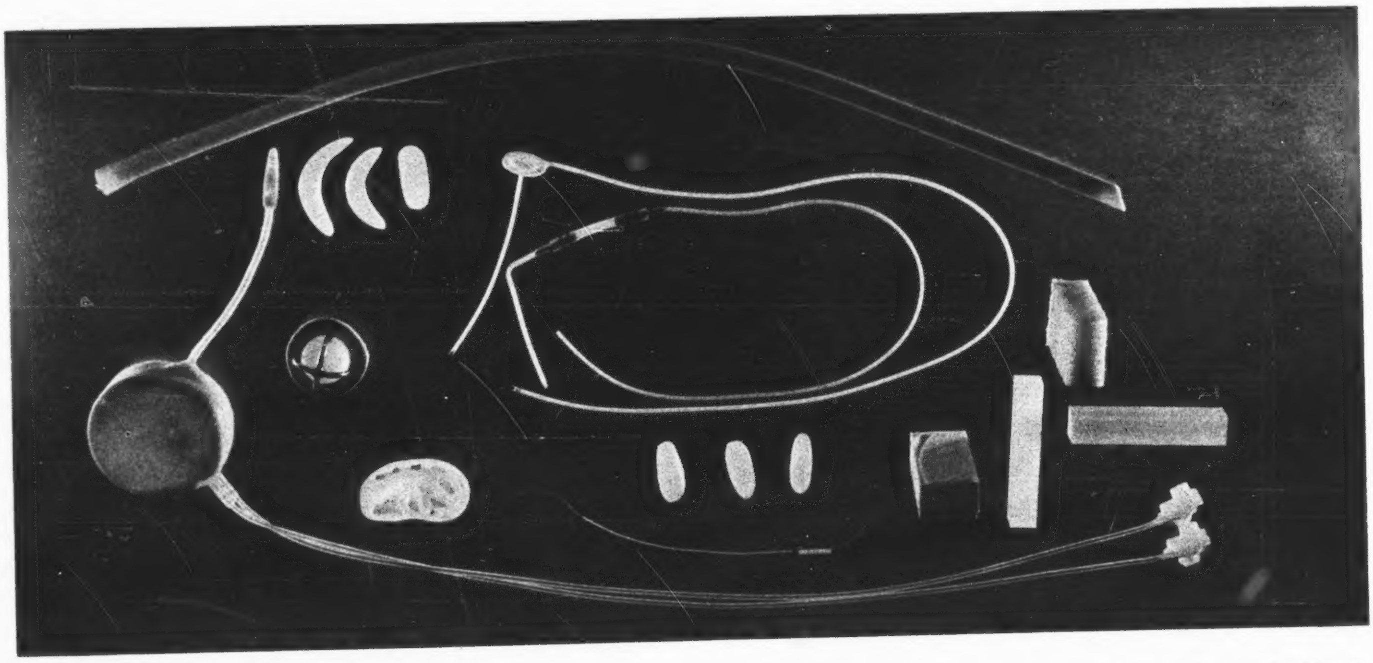
[26] *Wall Street Journal*, August 22, 1963.

[27] William E. Bushor, "Medical Electronics," *Electronics*, January 19, 1962.



*Artificial parts for the body are bringing a new era to medicine. Here are a number made of silastic including chins, ears, noses, and heart valves.*

Another development in modern surgery that has attracted wide attention is the use of hyperbaric oxygen chambers for performing surgical and other procedures. These chambers are constructed to withstand pressure much above normal, holding an atmosphere consisting of up to 100 percent oxygen. During the past few years, these chambers have been added to hospitals in various parts of the country. A typical chamber is 12 feet long and 8 feet in diameter, large enough to hold equipment, the patient, two nurses, two surgeons, and one anesthesiologist. The staff are all equipped with special air-breathing apparatus. The special atmosphere makes it possible for some heart patients, especially infants, to sustain surgery which their condition might otherwise not tolerate.[28] Hyperbaric chambers are also used for intensive patient care in several other conditions which do not require surgery, but do require treatment with elevated amounts of oxygen in the blood.

Considering these and all of the many other new developments that have been taking place in surgery, involving new equipment, materials, and techniques, it is evident that during the next 10 years many professional and other health workers will be needed and will have to be trained in new specialties, and that many changes in job content will be taking place affecting traditional jobs.

***Other Therapeutic Techniques and Materials.*** Outside of surgery, many important new developments have occurrred, just a few of which can be referred to here.

In the treatment of coronary heart disease, which accounts for over a half million deaths yearly and ranks as the greatest single health problem in the United States, a significant advance in dealing with acute heart attacks has been the establishment of specialized intensive care units in many hospitals. These coronary care units provide for continuous close observation of patients; they are staffed with personnel specially trained to deal with myocardial infarction. They are lodged in areas designed and equipped specifically for handling heart attack victims. The equipment usually includes the electrocardiograph, oxygen units, electrical beds, and intercoms. External continuous EKG monitoring equipment, and electronic devices such as defibrillators and external pacemakers, which help to restore normal heartbeat in case of cardiac arrest or other malfunction of the heart, are standard equipment in these units.

New techniques are being used widely in the treatment of cancer by various types of radiation devices, providing X-rays and gamma rays; equipment utilizing high-speed electrons is used in treating certain skin lesions. Hodgkin's disease, a type of cancer, is being treated with energy from linear accelerators.

In the field of dentistry, steady progress is being made in the development of materials for filling cavities. One type of material, still being tested, would require less drilling and would retain effectiveness much longer than materials now used. Another material being developed is an adhesive coating intended to prevent decay from forming in crevices of the teeth. Already in use are many improved drugs for treatment of gum troubles and other mouth diseases, and high-speed air turbine drills which allow dentists to prepare tooth cavities for filling more quickly and less painfully than with standard equipment.

One of the most significant developments in the field of medicine has been the development of drugs which help in the treatment and care of mental patients. These drugs, along with improved methods of psychotherapy, have aided many patients previously viewed as hopeless, and have greatly shortened average hospital stays of mental patients. They have also brought about substantial changes in the design, operation, and staffing of hospitals and other facilities for psychiatric care. Security is much less a problem, so the need for custodial manpower is reduced. Substantial rehabilitation is much more of a realistic possibility with many patients, so the need for personnel trained in psychiatric techniques has risen.

In the treatment of chronic respiratory diseases, such as tuberculosis, drugs have been so effective that needs for hospital beds and staff previously reserved for care of their victims have fallen off. Many other successes in the discovery and use of drugs in treating infectious and many other conditions have been achieved, and others are on the way. The range the drugs cover is so wide that a summary discussion cannot hope to deal adequately with their effects on the manpower needed to care for patients.

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[28] John C. Adams, "Hyperbaric Oxygen Therapy," *American Journal of Nursing,* June 1964.

## *Hospital Information Handling*

One of the most far-reaching developments affecting hospital technology is the use of the computer to handle the mass of information generated by hospital operating routine, in addition to its use in diagnosing and treating illness. Few businesses or other activities have needs equal to those of the hospital for speed and accuracy in the communication, recording, processing, and analysis of vital information. Much of this information is either the source or the result of physicians' written and verbal orders for treating patients, which must be carried out quickly and accurately. The results of observations of patients, of tests and treatments, are constantly being entered on patients' records. There is a continuous flow to the accounting department of charges to patients for medication, special equipment, or services. Patient and staff needs, and other requirements in the operation of a hospital, require many other records—for food preparation, housekeeping, maintenance, and other functions.

Since information handling requirements in hospitals are so massive and highly diversified, it is no wonder that the possibilities of using the computer have excited great interest. The computer's ability to communicate, record, process, control, and analyze different kinds of information, at unprecedented levels of speed, detail, and precision, provides an unusual tool for the use of the hospitals.

Like many types of business firms, hospitals began using computers for operations such as billing, payrolls, inventory, and related business applications. More recently, as capabilities of computer equipment advanced to permit almost instantaneous communication and manipulation of data, applications related to the special needs of hospitals have been put into effect. These applications have involved functions for which no parallel exists in business and related fields; functions of aiding doctors, nurses, and technicians in actual patient care. Some of these are readily put on the computer; others offer problems that must be analyzed in detail and tested at length before satisfactory handling by the computer can be achieved. These more difficult problems are being faced by a few hospitals that are working toward fulfilling the concept of a total hospital information system, in which the computer will be utilized to the full in patient care, business, and other functions. Total systems will be installed eventually in many hospitals, and will have substantial effects on the number of health workers needed and their occupations.

***Present Status of Information Handling in Hospitals.*** An effort to show the many possibilities and needs for the use of computers in hospitals on a detailed basis would take up more space than can be allowed here. Some idea of the status of information handling in key hospital departments is provided by the tabulation in exhibit 3. Separate columns summarize some of the main types of information used or prepared in key departments, the actions they relate to, and shortcomings in the existing systems. For most of the departments shown, the activities and records referred to represent only a portion of the total scope of the department. Some activities, such as handling the vast amounts of information that need to be read, written or otherwise communicated—in activities such as medical study, consultation, research, and teaching—are not shown at all.

*Serious inadequacies exist in present systems of information handling in key hospital departments.* During the past few years many studies have revealed serious shortcomings in the data handling procedures used in hospitals. They show that a large proportion of the time of scarce professional workers must be devoted to routine paperwork and that existing record systems permit errors on a large scale and fail to record vital information.

Evidence from only a few studies will be cited here; they deal with nursing service. Direct patient care by nurses is the most basic of all

## EXHIBIT 3—SOME ASPECTS OF INFORMATION HANDLING IN KEY HOSPITAL DEPARTMENTS

| Department or service | Uses or prepares information on | Main actions taken | Shortcomings of the existing system |
|---|---|---|---|
| Admitting. | (1) Doctor's orders for immediate care, tests. | (1) Sets up appointments. | (1) Scheduling problems causing patient waiting, failure to use facilities. |
| | (2) Bed availability. | (2) Assigns room. | (2) Tardy or inaccurate information. |
| Nursing service. | (1) Doctor's orders for medication. | (1) Receives, transcribes, transmits orders; gives medications. | (1) Orders are sometimes inaccurate due to incompleteness or illegibility. |
| | (2) Changes in doctor's orders. | (2) Changes treatment as needed or directed. | (2) Data on changes or cessation of orders often received late. |
| | (3) Maintenance of patient, medication, other records. | (3) Regularly enters data on patient chart, various other records. | (3) Paperwork excessive, yet needed records are often incomplete, and not organized in most effective form. |
| Pharmacy, laboratory, X-ray, physio-therapy. | (1) Item or procedure requested. | (1) Provides item or completes procedure. | (1) Orders sometimes not given accurately or too soon, or too late. |
| | (2) Charge for item to patient. | (2) Sends charge to accounting. | (2) Patient charges often erroneously omitted or sent out late. |
| | (3) Maintaining stock inventory. | (3) Maintains inventory record. | (3) Difficult to maintain satisfactory inventory records, present method. |
| | (4) Individual and summary patient reports. | (4) Prepares records for each patient. | (4) Difficult to prepare satisfactory summary records for each patient. |
| Dietary. | (1) Arrival, location transfer, discharge of patients. | (1) Starts, reroutes, or stops meals. | (1) Frequent mistakes, inconvenience, waste. |
| | (2) Special diets or diet holds for patients about to take tests or enter surgery. | (2) Changes or holds meals as directed. | (2) Frequent mistakes; delays in test or surgery. |
| | (3) Maintaining food inventory and purchase records. | (3) Maintains records. | (3) Hard to keep adequate records with present system. |
| Medical records. | (1) Full records of each patient's history and treatment. | (1) Obtains reports. assembles folders. | (1) Limited capability for auditing or research use of data in present form. |
| | (2) Preparation of abstract in convenient form. | (2) Codes data to card records. | (2) Mistakes, heavy workloads. |
| Accounting. | (1) Patient third party coverage or credit standing. | (1) Obtains information on admission. | (1) Complex problems due to multiplicity of plans. |
| | (2) Patient charges for invoicing. | (2) Record charges prepare invoice. | (2) Some charges often omitted or received late. |
| | (3) Payroll and accounts payable payments. | (3) Prepare payroll, other payments. | (3) Usually few problems, but heavy workloads. |
| | (4) Various accounting system records. | (4) Maintain accounts, other records. | (4) Not much useful detail derived under present system. |

services provided by hospitals. As previously noted, nursing personnel represent roughly half of the staff of most hospitals; it is several times as large as any other group. The shortage of trained professional nurses makes it extremely important to use their time at the maximum level of their skill. According to a careful study in a fairly representative hospital, about 40 percent of the nurses' time was spent in activities other than direct patient care, mainly paperwork activities. This study showed that under current practice 1 physician's order could generate as many as 15 forms.[29]

Other studies have shown conditions such as the following:[30]

—at one university hospital, one-sixth of all medication doses given by registered nurses were in error.

—at a representative group of hospitals in the San Francisco Bay area, the forms used to record physicians' orders for medication were rudimentary, and did not clearly require information essential for protection of the patient. As a result some such information was frequently omitted (resulting in guesswork or neglect on the part of the nurse) ; other information was frequently abbreviated or otherwise provided in a manner that was unclear.

*Equipment presently used in most hospitals for handling information has limited capabilities.* In most hospitals (including many large hospitals), the office equipment used today in nursing units, medical records departments, accounting departments, and other units is about the same as the equipment used in offices of single active medical practitioners for many years: Typewriters, file cabinets, kardex files, calculators, and bookkeeping machines. Only a small number of hospitals have installed electric punched-card equipment, electronic computers, microfilming, or other specialized equipment for handling medical records or business data.

Adoption of the computer would not eliminate the need for materials or equipment conventionally used in handling medical records and other information. Index cards, handwritten forms, and other records would still be needed, and assembled and stored in individual file folders, for each patient or subject. Use of microfilming is spreading very slowly in hospitals. Spreading more rapidly are improvements in the physical handling of index cards and file folders, such as equipment designed with automatically controlled rotating file trays and folder racks, operated by pushbutton. Equipment such as this, now being installed in many hospitals and clinics, saves space and reduces clerical time and effort in filing and retrieving information.

Although not many hospitals have installed advanced equipment for mass data processing, this picture is changing rapidly.

A 1963 survey of all registered hospitals of the American Hospital Association (more than 7,000 hospitals), showed that the proportion of hospitals with any kind of automatic data processing installation was very small. Only 7 percent of the reporting hospitals (less than 400 hospitals) had either electric punch-card equipment or electronic computers. Only 39 hospitals were using computers. The chief uses of data processing equipment are for payroll, billing patients, and inventory control. Applications such as medical records and research were reported only in a small fraction of the hospitals involved.[31]

By 1965, however, the number of hospitals that had either installed or ordered computers was believed (by computer industry sources) to exceed 200. Most of these were large hospitals. It is evident from many indications that use of computers in hospitals will spread in the years that lie ahead.

***The Promise of the Computer.*** The relatively small proportion of hospitals using computers in 1963 reflected the fact that, as they were then being used, they offered relatively few advantages in comparison with carriage bookkeeping machines, desk calculators, and similar less advanced equipment, when their use was limited to business developments.

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[29] James P. De Marco and Shirley A. Snavely, "Nurse Staffing With a Data Processing System," *American Journal of Nursing*, October 1963.

[30] Jacqueline A. Drew and Mark S. Blumberg, "What Happens to Medication Orders?" *American Journal of Nursing*, July 1962.

[31] Raymond H. Giesler, "How Many Hospitals Use Automatic Data Processing Equipment," *Hospitals, Journal of the American Hospital Association*, January 1, 1964.

However, widening adoption of the computer for helping with patient care and other complex technical activities promises to bring into the hospital real improvements in quality of patient care, as well as lowered dollar costs and savings in the man-hours and energy demanded of scarce personnel. Moreover, the computer lends itself readily to shared use among hospital functions, such as patient care and business, and among hospitals and other users.

*The computer will make possible an improved level of patient care by reducing or eliminating delays and errors in carrying out physicians' orders, by reducing the nurses' load of paperwork, and by providing other aids to patient care.* How such gains may be achieved is described as follows, in reference to the total hospital information system being developed in the Children's Hospital of Akron, Ohio (discussing the procedural sequence beginning with the physician's order for a medication as it is handled by the nurse or other operator of the computer input unit): [32]

> If a physician prescribes "tetracycline 250 mg. caps. every 4 hrs.," for a patient, the operator will enter the patient's number and medication order by numeric code in the input unit. The control system will immediately decode the information and print it in English, on the adjacent output printer. Thus, for example: "432671147041 Jones, J. F.: 403–1, tetracycline cap., 250 mg. 04 hrs., oral." After visually verifying this with the physician's written order, the operator will depress the "transmit" button, causing the order to remain in the system. If the printback does not agree with the original order or if the operator hesitates beyond a present interval, the control system will reject the order. If the nurse uses a nonexistent patient number, order code, or frequency, the machine will immediately notify her by indicating the type of error and corrective procedure such as: no such patient, reenter; no such order, reenter; no such frequency, check; or unreasonable order, check.
>
> In most instances, the order will be proper and the operator will verify the order correctly. It will be stored in the system's memory and used in other procedures such as:
>
> 1. It will be added to the 4-hour medication schedule for that particular nurses' station.
> 2. It will be made part of the patient's profile.
> 3. It will be included in the pharmacy order output.
> 4. It will be the basis for verifying the administration of the drug each 4 hours.
> 5. The last order dose given will be indicated so that inquiry can be made as to whether or not the doctor wishes to reorder this medication.
> 6. Finally, the order stored in the memory system will serve as the initiation of a patient charge.
>
> When the time comes for this medication to be administered, the output printer will produce this medication order along with all others pertaining to the particular station in room and bed sequence. Inherent in this medication schedule is a code number that can be utilized by the nurse to verify that all medications on that schedule were given. The patient's medical profile will be automatically updated so that the doctor will know that this medication was administered, at what time, and by whom. This controlled order procedure as shown in this example offers seven advantages:
>
> 1. The order has been verified to reduce errors.
> 2. Nursing clerical effort is minimal, because medication cards, record card filing, and charting have been eliminated.
> 3. All documents are legible.
> 4. The scheduling and control of this order has been handled automatically.
> 5. The patient charge is entered for accounting.
> 6. The drug inventory is relieved and updated by the amount given.
> 7. The order has been compared automatically with patient

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[32] Charles M. Campbell, "Information System for a Short-Term Hospital," *Hospitals, Journal of the American Hospital Association*, January 1, 1964.

characteristics for an unreasonable
order and allergy check.

The procedure for handling physicians' orders for laboratory tests, X-rays, and all other major hospital functions will provide similar gains in communication, recordkeeping, and control.

The computer can perform many other functions important in specialized patient care situations. For example, in mental hospitals it can help score personality and make other tests to analyze the progress of patients toward cure, and provide a convenient instrument for noting observations of the behavior of patients in need of constant watching. Dr. Bernard Glueck, in an article on the use of computers in patient care in such hospitals, describes how, in an installation having many convenient computer terminals at which staff members could constantly report observation on patients, the computer could predict that an individual was likely to attempt to escape or become violent and give an appropriate warning in time for needed precautions to be taken. Individual staff members could not have at their fingertips observations on the patient made by all staff members during the day or days before an episode. The computer, assembling, accumulating, and weighing the actions of patients reported according to a carefully developed program, would inform the appropriate personnel about an individual patient's behavior if a designated warning threshold was approaching.[33]

*The computer can raise the quality of patient care by improving the storage and retrieval of patient medical records and by helping to interpret EKG, X-ray and other pictorial representations of illness.* With the case histories of many individual patients stored and classified in the computer, it is easy for the physician to refer to past experience in treating particular patients. Availability of such data in convenient form will also facilitate professional review or audit of patient treatment. The use of the computer in interpreting EKG and X-ray reports, and for diagnostic analysis utilizing statistical techniques on the basis of information stored in the computer (as described earlier in this chapter), will provide additional help to the physician.

*The computer will save patients' time and money by helping to avoid errors or oversights on appointments, diets, or other factors involved in stays at hospitals.* The computer helps to improve the system of admitting patients to hospitals, by its ability to communicate instantaneously to each of the different units involved information related to scheduling of appointments and to facilitate arrangements for actions by several different units in proper sequence. A specific case in point is the frequent need for special medication, or a diet change, the day before a patient is scheduled to undergo an X-ray procedure. Failure to get information on such requirements communicated in time—not only to all nursing personnel involved but also to pharmacy, dietary, and radiology departments—will result in needless wastes of time and money. A slip-up is likely to cause a delay requiring the patient to spend at least 1 more day in the hospital than would have been needed otherwise.

*The computer can expand income and reduce expenses of the hospital by increasing the occupancy or usage rates of beds and other facilities and by reducing inventories and personnel needed.* Under present circumstances, many hospitals operate with substantial proportions of beds always unused (on the average, according to American Hospital Association statistics, about one-fourth of all short-term hospital beds are vacant at all times) and with low use of operating room and other specialized facilities. As a result, the hospital's income, as well as its opportunity for service, is lessened. To some extent this is attributable to delays in communication between nursing stations, admitting, and other departments. Hospital computer systems can provide channels of information and scheduling arrangements to minimize such unused capacity. Similarly, computers can save money for the hospital by showing the minimum levels of inventory required to meet actual needs of the dietary, pharmacy, and related departments and by scheduling nursing and other staff time requirements in relation to actual and expected needs. These applications of the computer can substantially reduce a hospital's capital fund requirements as well as its operating costs.

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[33] Bernard C. Glueck, "The Use of Computers in Patient Care," *Mental Hospitals,* April 1965.

*The computer can greatly improve the operation of billing, accounting, and other departments by raising the levels of speed, accuracy, and detail in which operations can be carried on.* The procedures used in carrying out doctor's orders, for example, assure instantaneous reports to the accounting department on charges to the patient for medication or special services. This reduces possibilities for missing charges or reporting charges after the patient has been discharged from the hospital. One of the most difficult problems of the hospital's accounting department is the multiplicity and variety in provisions of medical cost coverage plans. Many hospitals must contend with hundreds of third-party arrangements in billing for treatment of patients. This problem, which will become intensified when the provisions of the Medicare programs take effect, can be handled much better by the computer than by procedures presently in effect in most hospitals.

These are only a few of the many procedures in the business department as it relates to the functions of the hospital for which the computer offers special advantages. Apart from such purely accounting applications, the computer makes it easier to do special cost analyses and related administrative and statistical studies needed to improve hospital management. The Medicare program specifically requires hospitals to provide reports that necessitate cost accounting, which will be a new practice in most hospitals. The computer can provide calculations involving either simple repetitive procedures or complex analyses such as are needed in various departments of the hospital. The computer is an especially valuable aid in the clinical laboratory, which requires a large volume of computations in preparing reports on the results of tests, and a large volume of paperwork to summarize reports for individual patients. The computer can also take over a substantial load of paperwork in the medical records department, the pharmacy, and the dietary department.

*The computer can help carryout many other programs, such as medical research, teaching, and communicable disease control, especially when computer networks develop on a regional and national basis.* Computers are currently being used as teaching machines and in medical research. These activities will expand when more and more hospitals get computers linked by remote data transmission. It is expected that ultimately regional and national networks of hospitals with computers will be available, to pool information instantaneously when cases of serious communicable diseases are diagnosed, thereby aiding control of epidemics, as well as providing a general store of immediately retrievable information on medical case histories.

***The Slow Pace of Computer Adoption.*** Adoption of the computer in hospitals has been quite slow by comparison with the pace of computerization in fields such as insurance, trade, and transportation. Discussion of the possibility of using the computer in hospital applications dates back to 1958 or earlier. Yet, as of 1965, only a small number of the Nation's hospitals have computer installations. There are various reasons for the slow advance in computer adoption.

*Hospitals are currently following or planning several different approaches to computer applications.* It would be hard to list and count all the possible applications of the computer in a hospital, but they can be grouped into three categories:

1. Selected operational applications, such as patient billing, accounting, inventory, and other repetitive data processing operations in the business department; also computation, scheduling, and data-arranging work in the laboratories and in medical records and dietetic departments.

2. Applications related to diagnosis of illness and continuing clinical care analyses, and to medical research of various kinds.

3. Total hospital information systems for patient care, consisting of communication, control, data processing and scheduling activities of many kinds, embracing also the business, diagnostic, and other clinical and research applications referred to above, and extending further to teaching and other applications.

Most hospitals that have computers are using them mainly in the first category—especially in the business functions. A smaller number of hospitals are using computers to aid in diagnosis, in clinical research, and in related applications involved in the second category.

Very few hospitals, thus far, are actively working toward making the computer the basis of a total hospital information system. In fact, up to 1965 there were no hospitals in which such a comprehensive system was actually in operation. Nevertheless, most hospitals that currently limit their computer applications to business and similar functions, or to medical research activities, expect to expand them toward the total hospital information system concept eventually.

*In many hospitals it would be difficult to justify the costs of computer installation and operation if the equipment continues to be used mainly for business functions and related mass data processing applications.* Computer feasibility studies have often shown that its use does not result in lower costs of data and record processing in the hospital's business operations, by comparison with conventional equipment presently in use. Faced by such evidence, many hospital authorities have shied away from introducing the computer. In some hospitals, where the decision was made to go ahead with computer installation, it was partly the greater speed and detail made possible by the computer in providing patient bills and accounting information, and partly expectations of the ultimate extension of the computer's applications, that led to adoption of the computer. Plans for the growth of these hospitals were designed to include eventual reliance on a total information system based on the computer.

Different patterns of equipment ownership and shared usage may be found among hospitals that are using computers. Many large hospitals have their own individual computer installations. In other cases, regional and local groups have set up arrangements for shared use of computers, usually for business-type applications. Some of these are local groups which utilize computer services in conjunction with the area Blue Cross organization. A regionwide approach is taken by the 12 hospitals and other institutions of the Sisters of the Third Order of St. Francis, which has a central installation in Peoria, Ill., handling the payroll, accounts payable, general ledgers, and other accounting applications for hospitals in Michigan, Illinois, and Iowa (including one hospital 550 miles from Peoria). Other regional and local groups are sponsored by hospital associations and local planning councils.

The hospitals in which use of the computer has been focused on diagnostic and medical research applications have mostly been institutions connected with medical schools. Among them are many large, well-known institutions, such as the Presbyterian Hospital (associated with Columbia University) in New York City, the University of Texas M.D. Anderson Hospital and Tumor Institute (Houston), the University of California Hospital (Los Angeles), Massachusetts General Hospital (Boston), and the University of Missouri Medical Center (St. Louis).

*Progress toward achieving an operational hospital information system has been slow.* After several years of effort and substantial expenditures of funds toward developing total hospital information systems, such systems are still not ready, in any hospital, to take over the full role for which they were planned. They are approaching readiness at two hospitals, Children's Hospital in Akron and at the hospital of the Veterans Administration in Washington, D.C., and sooner or later will show whether they can perform as well as is hoped. During the first year or two after the systems in these hospitals start to handle physician's orders and related clinical applications, these systems will be working simultaneously with, and duplicating, the hospitals' existing communication, control, and recording systems. These will not be abandoned until the new system is completely tested.

At the Akron hospital the foundation for full-scale operation has been laid, after much effort and patient experimentation. Basic computer hardware has been acquired and installed, consisting of a battery of equipment at the central unit and 15 input-output terminals located at nursing stations and key department centers. The installation has been providing useful information for a limited number of hospital functions on a routine basis, and has been operated successfully in test runs of operations nearly approaching total information system specifications. But much more work remains to be done before an independent system of total hospital information communication and control will be functioning.[34]

The Veterans Administration (VA) plan provides for an "automated hospital information system" that will service individual VA hospitals and also provide a network using teleprocessing communication to embrace all VA patient care institutions. The Veterans Administration Hospital in Washington, D.C. is the site of the pilot system, where the development work is proceeding. It appears likely that a functioning hospital information system will be achieved in the Washington hospital in 1966–67. During the initial period, the system will still be considered experimental. It may take another year or two before the system will completely replace previous methods of operation. Early in the 1970's, if all goes well, the VA is likely to have a growing network of hospitals with operational information systems functioning out of regional computer centers which will provide time-shared service instantaneously to individual hospitals as well as to the VA central office in Washington.

***Future Pace and Its Implications.*** Of wide interest is the question of how rapidly use of the computer may be expected to spread among the more than 7,000 hospitals in the Nation. The answer will depend largely on how long it will take to demonstrate, from the experience of hospitals that have computers, that substantial gains can be realized from its application not only in diagnostic, research, and business department applications, but also in the wide variety of applications that make up a total hospital information system.

The authorities at each individual hospital for which the installation of computer equipment is being considered must first decide on the kinds of applications they are principally interested in and their priorities. Then they must prepare for several weighty decisions.

Choices of the kind of hardware (i.e., computer equipment) to acquire call for extensive study and discussion. Of obvious importance is study of costs in several categories: Equipment rental (or purchase) costs, installation and conversion costs, software development (programs, etc.), and routine operation (mainly personnel). Among other factors that must be considered are: Differences in capacity, speed, and flexibility and other properties of equipment offered by competing manufacturers; possibilities of sharing computer equipment, using service bureaus, or entering into other contractual sharing arrangements with computer users that may reduce costs (but also may reduce the convenience of the system); extent to which it will be feasible to make use of standard software, i.e., standard programs prepared by equipment manufacturers as a special service to a class of users, such as hospitals.

The problem of preparing and adapting software for use in the individual hospital is one of the most costly elements of putting the computer to work in various applications. It calls for intensive and continuing study of the hospital's procedures, and for repeated testing of the programs that are developed.

The question of availability of qualified personnel to prepare programs, carry on operations, and properly maintain the hospital's computer installation is another aspect of major importance.

Special problems of a particular hospital may delay or complicate decisions on automation. The attitudes of a hospital's trustees, professional staff, or other personnel toward adopting the computer may be a major factor affecting decisions. Reluctance to install it is often attributable to awareness that the equipment cannot realize its promise unless personnel in all affected departments are willing and competent to use it properly. Human beings must be depended on to provide the computer with data input as needed, and to make proper use of its potentially great output of timely communications, detailed calculations, and summarized records. Otherwise, installation is likely to be a waste of time and money.

Most hospitals seriously considering installation of computer equipment begin with one or more feasibility studies. There is a developing tendency toward using outside consultants for such studies, not only because of the advantage of using unbiased advisers in contrast to relying solely on recommendations of representatives of computer manufacturers, but also because of the value of a detailed review of the hospital's procedures by qualified outside experts, even if the decision is not to install a computer.

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[34] Charles M. Campbell, "Akron Speeds Information Systems Slowly," *Modern Hospital*, April 1965.

Equipment currently being ordered or installed has increasingly large capacity and speed of operation, and provides practically simultaneous service to multiple users, for completely differing operations. Whereas much older equipment was based exclusively on punch cards, new equipment makes use of different types of terminals and terminal equipment depending on the particular application: Typewriters, templates for typewriter keyboards, telephones, optical scanners, and video screens.

An interesting example of a project for developing methods of using equipment in accordance with special needs in the medical field is the work being done at El Camino Hospital (Mountain View, Calif.). This project is an effort to work out phases of a hospital information system utilizing a video input-output device, to replace or supplement keyboard terminals. The purpose is to develop, for each particular subsystem in the operation of a hospital—such as medication, laboratory, radiology, etc.—sequences of matrix displays for showing on a screen. The physician can communicate his orders by using a "light pen," which he touches to a spot on the screen, to show his choice among alternatives in the array presented to him at the display unit.

The procedure works this way: [35]

> After identifying himself to the system with a magnetic card, the physician is immediately presented with sequences listing all of his most frequent information handling tasks. Assuming he chooses "medical orders" and then "medications," he is presented with an array of drug classes. Among these (it may be assumed) he chooses "cardiotonics." Then, from the cardiotonics display, he chooses "digitalis leaf," the drug he wants. This drug selection will thereafter during the sequence appear continually at the top of the display; a drug specific-dose matrix comes up, after which the physician selects the proper dose. After dosage selection, the route matrix is called up, and the physician selects the desired route. The ordering continues with selection of drug administration frequency, after which the physician must verify the complete order as it now appears at the top of the display. Finally, the complete order is identified in regard to the patient for whom it is intended.

Systems of this kind can be developed to help reduce the amount of paperwork required of doctors and nurses, save man-hours, reduce possibilities of error, and otherwise aid in improving patient care. They may also be useful in training medical and paramedical personnel.

The pace at which computers will spread between now and 1970 will probably be moderate. Computer acquisitions will be confined mainly to larger hospitals, which will initially use the equipment mainly in business, laboratory, diagnostic, and research applications. Time-sharing arrangements among groups of hospitals will also spread, making it possible for medium-sized and smaller hospitals to obtain instantaneous electronic data processing services.

After 1970, the spread of computers among hospitals will be more rapid. By 1975, it may be expected that most large hospitals, as well as many smaller facilities, will depend on computers of their own, or at least on membership in a network of hospital computer services, to carry out a wide variety of hospital functions.

If these expectations are realized, the manpower implication of the spread of computer use during the next 10 years will not become substantial until late in those years. Currently, hospitals that install computers for use in business applications assign between 5 to 12 persons to staff them: Programers, systems analysts, console operators, and key punch operators. In some cases, these persons represent net additions to the total hospital staff; in others, the number of persons added to the computer staff equals or falls short of the number of jobs displaced by the adoption of the computer (displaced employees being usually transferred to the computer unit or elsewhere). Slightly larger staffs will be needed with widening of the functions for which the computer is used. Perhaps savings in personnel may become most evident in situations providing for shared use of computers by several hospitals, instead of individual computer installations.

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[35] *Hospital Information System Experiment* (Sunnyvale, Calif.: Lockheed Missiles & Space Co., 1965), LMSC–894033.

Although some individual hospitals will quickly realize substantial laborsavings from the installation of computers, especially in business departments, the health service industry as a whole is not likely to realize significant net savings before 1970. As 1975 approaches, savings in manpower may become substantial—in clinical laboratory, medical records, dietary and other departments—as well as the business department. This is unlikely to cause layoffs of hospital personnel, considering the assured growth of demand for hospital beds. The effect will be to increase the number of patients who can be serviced with existing personnel, reducing the necessity for expansion of staffs in some departments. Other costs, as well as labor costs, will be held down and levels of quality in patient care will rise.

Apart from the effects on manpower needs and costs and quality of patient care resulting from actual adoption of the computer, the spread of interest in its possible adoption is likely to have some effect on the amount of manpower needed in hospitals because of feasibility studies conducted in many hospitals during the years ahead. Hospital administrators learn from these studies not only how computers may be used, but also how fairly simple improvements in records, procedures, or equipment can bring about substantial gains in efficiency.

## *Developments Affecting Hospital Supply and Service*

Another major category in which technological developments in health service establishments are occurring is hospital supply and service. The hospital departments concerned include: Pharmacy, central service (processing of medical and surgical supplies and equipment), laundry, housekeeping, and general building maintenance.

***Central Service, Pharmacy, and Laundry.*** The main function of central service is to provide supplies and equipment used by all departments that render patient care, meeting their requirement regarding time of delivery, quality, quantity, and condition for use. The scope of the services rendered depends on the individual hospital. Typically, they include the following:

1. Receiving, storing, controlling inventory, and distributing sterile and unsterile supplies purchased from manufacturers, including disposable items and commercially prepared intravenous and external solutions.
2. Collecting, cleaning, sterilizing and other processing, and redistributing of reusable instruments and supplies, such as surgical gloves, needles and syringes, catheters, and treatment trays or sets used by the medical, surgical, and obstetrical departments.
3. Maintaining and issuing portable apparatus such as resuscitators, oxygen tents, wheelchairs, orthopedic appliances, surgical and emergency equipment, and providing instruction in use of such apparatus and equipment.

Central service is attached to the division of nursing in many hospitals; in others the central service supervisor reports either to the chief of pharmacy, the head of the operating room, or to an assistant hospital administrator. A growing trend is toward consolidating the central service unit with other services (the hospital laundry, the hospital pharmacy, and general stores) to form a central service department headed by an assistant administrator.

The staff of the central service unit usually ranges in size from 5 employees in hospitals with 50 to 99 beds to 32 employees or more in large hospitals. It usually includes one or more registered nurses and practical nurses; the remaining staff typically consists of assistants and messengers trained on the job. In some hospitals, volunteers help in this unit.

In most hospitals, central service is headed by a registered nurse, but opinions differ among hospital experts on whether this is necessary. A trend is growing toward heading the service with an experienced manager not trained as a nurse, but to have a professional nurse as a member of the advisory committee on central service.

*The development of specialized, centralized units for service of medical and surgical supplies and equipment is a major step toward improved hospital management, reducing labor requirements through greater efficiency in processing supplies.* Up to a decade or so ago, central service did not exist as a separate service in most hospitals. Where it is not separate, the sterilization and other processing work is done in the individual nursing units. Sterilization equipment tends to be duplicated on many hospital floors; this means that nursing personnel, whose primary job should be patient care, are frequently distracted by needs for processing supplies or equipment.

A typical example of laborsavings from adoption of the central service principle is shown by a study over a period of years of central service activities in one general hospital. In 1955, the preparation of a catheterization setup was carried out, as needed, by a registered nurse in a nursing unit. This involved 18 workload items, 4 of which were unsterile, and took 6½ minutes. Beginning in 1956, the same setup was prepared in advance, by a nurse aide in central service. The procedure then involved 13 items, 2 of which were unsterile, and took less than 1 minute. Today a catheterization setup can be purchased in completely prepackaged, sterile form, for one time use, at reasonable cost.[36] In this form it involves practically no labor requirements inside the hospital. Currently, central service functions are undergoing drastic changes in many hospitals because of the spreading use of such "disposables." This trend is resulting in signifiicant further reductions in man-hour requirements. The extent and significance of the adoption of disposables is discussed more fully in a later section.

*Improvements in hospital pharmacy service are being introduced to overcome inadequacies in conventional methods of dispensing drugs to hospital inpatients.* The older and still prevalent method requires nursing personnel to measure medications for patients from bulk packages supplied by the pharmacy. Studies have shown that a large proportion of nursing time (about one-sixth, according to one study) is spent maintaining records concerned with medications and preparing single doses. Aside from the high cost of this system, it has numerous serious imperfections, including the possibility of medication errors, lack of flexibility in dosage patterns, and imperfect summary records for attending physicians to use.[37]

Two approaches are being taken toward remedying this situation. One is the use of a specially developed system involving a mechanized drug station and specially designed drug cart at each nurse station, which has built-in controls to assure that errors in administering medication are avoided and that costs of drugs are charged to the patient. It uses electronic locking mechanisms and addressograph plates, on principles resembling those of vending machines. The other approach involves use of medications packaged for single dose use, in strips, or otherwise.

One of the obstacles to the spread of the mechanized system is that some States have legal prohibitions against the use of mechanical means for dispensing drugs. Legal and professional requirements concerning the personal participation of the pharmacist in dispensing drugs to patients are also considered in some instances to be barriers retarding growth of single dose packaging of medications.

*Improvements in hospital laundry techniques promise significant reductions in manpower requirements.* Whether or not laundry service is included in the administrative control which supervises central service in a particular hospital, it is usually situated near central service in the hospital building. This is convenient, because, like surgical supplies, some hospital linens must be sterilized after laundering. Most work done in the hospital laundry, however, does not require cleanliness higher than that maintained in hotel linen supply.

Many hospital laundries have been keeping up with the steady pace of improvement in equipment used in the laundry industry. In so doing, hospitals have realized noticeable gains in laborsaving. Many examples can be found, but only one will be cited here. At Mercy Hospital, Muskegon, Mich., it was found that the replacement of two washers and two extractors by two new model washer-extractors made unnecessary the work of three employees (who were thereupon transferred to other departments) even though a substantial increase in the patient care workload occurred soon after the new equipment was installed.

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[36] Josephine A. Jones, *Progress in Patient Care Procedures* (Evanston, Ill.: American Hospital Supply Corp., 1965), p. 13.

[37] Mark S. Blumberg, "Packaging of Hospital Medication," *American Journal of Hospital Pharmacy*, June 1962.

Currently under development is a continuous conveyor washing-drying-ironing system said to promise spectacular gains in man-hours. Advances in automatic mark reading, inspecting, folding, sorting, and bundling are also expected.[38] But the equipment will be relatively expensive, and may be beyond the reach of small hospitals.

A trend that seems to be gaining momentum at present, especially among small hospitals, is the purchase of services from outside laundries on contract. This movement may accelerate if contractors adopt the new automated equipment and are thereby enabled to perform services at lower cost than the hospital's laundry department.

Because of these trends toward laborsaving machinery and outside contracting, and a possibility that use of disposable bed linens (not used much up to now) and other linen items will grow, the number of laundry workers in hospitals may decline substantially in the future. But in all likelihood, the effects will be felt slowly and gradually over the next 10 to 20 years.

***The Dietary Service.*** Technological developments in food preparation and service are resulting in substantial laborsavings affecting kitchen work and food delivery. Kitchens are being designed with new equipment, often all-electric, including improved ranges, refrigerators, conveyor units for assembling trays, and dumbwaiters and carts for delivering trays to nursing units. Carts are equipped with hot compartments for trays holding the main course and cold compartments for salad and dessert dishes. The preassembled meals are delivered immediately to patients, often by dietary department workers, minimizing the time required for patient feeding on the part of nursing personnel. Many of the new systems replace arrangements under which bulk-cooked food are delivered to nursing units. The older system requires nursing personnel to spend much time preparing and serving food trays.

Improvements in kitchen and serving equipment have not only made it possible to shift duties from nursing to kitchen personnel but have reduced manpower requirements in the kitchen. In St. Luke's Hospital, St. Paul, Minn., for example, a changeover to new equipment to handle an increase in patient load was made during an expansion of hospital facilities; manpower requirements in the dietary department increased only 3 percent, while meals served went up over 20 percent.[39]

Other innovations that have been significant in some hospitals have involved increased reliance on food preparation outside the hospital by contracted services. One type of service is the same as some airlines use. Microwave ovens are installed in the hospital kitchen to heat the precooked frozen dishes delivered by the contractor. In many hospitals, automatic food vending areas have taken over part of the load of food preparation, providing snacks or light dishes for hospital personnel, guests, and ambulatory patients.

There has been a revolution in the dietary department's formula room, based on the purchasability of prefilled disposable infant nursing bottles. In Akron Children's Hospital, for example, the use of these bottles in place of preparing formulas on the premises and cleaning and filling baby bottles has made it possible to transfer three employees to other work.

Hospital feeding involves many problems associated with special dietary needs of patients, "withholds," and changes in food menus. Many hospitals are finding that the great mass of paperwork required to operate dietary departments can be reduced by improved data processing methods. Several hospitals are enlisting the services of the electronic computer to plan menus and analyze inventories.

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[38] Mark S. Blumberg, "New Hospital Laundry Techniques Are Coming," *Modern Hospital,* May 1962, p. 14.

[39] D. R. Sohlstrom and R. Sudeith, "Technological Change in a Hospital," *Employment Service Review,* May 1965, pp. 25–26.

***The Switch to Disposables.*** Tremendous changes are being made in the materials used to make the everyday articles consumed in hospitals. Products meant to be thrown away after one use—made of paper, plastics, and other inexpensive materials—are taking the place of many items that require cleaning, sterilizing, or other reprocessing. Products designed for use one time (or several times by a single patient) are called disposables; products reprocessed for multiple-patient use, in the traditional way, are known as reusables.

Earlier discussion has referred to disposable catheter setups and formula-filled baby bottles. These are only a few of the items currently being used in disposable form by some hospitals, and by no means the most important. A full list, as presented in exhibit 4, shows that disposable items are available to take the place of many important

### Exhibit 4—Disposable Products Used in Health Facilities [40]

*Central supply*

Sterilization bags
Sterilization wraps
Stopcocks

*Food service*

Aprons
Cups
Flatware
Napkins
Plates
Sandwich bags
Service sets for isolation cases
Tray covers

*General*

Ashtrays
Hypodermic needles
Intravenous administration sets
Mortuary packs
Soap dishes
Syringes
Tongue blades
Towels
Thumb forceps
Urinal covers
Washcloths
Waste collection bags
Wipes

*Laboratory*

Animal cages
Basal metabolism mouthpiece
Blood lancets
Blood specimen collection sets
Cover slips for microscopy
Culture tubes
Cytology specimen collection sets
Funnels and beakers
Micro hematocrit tubes
Petri dishes
Pipettes
Specimen cups
Sputum cups
Urine specimen bottles
Wintrobe tubes

*Obstretrics*

Breast pads
Diapers
Nurser system with formula
Tape measure, newborn
Umbilical clamps

*Patient*

Basins
Bathmats
Bedpan covers
Bed underpads
Blood administration and collection sets
Catheters (urethral, Foley)
Cleaning cloths
Cotton-tipped applicators
Denture cups
Drinking glass covers
Enema administration sets (some prefilled with enema solution)
Examination gowns
Head halters for cervical traction
Identification products
Intravenous therapy armboards
Medical collection bags
Medicine cups
Medicine droppers
Oxygen canopies
Razors
Sheets and pillowcases
Slippers
Straws, drinking
Tubes for feeding, enema, intravenous, fluid, oxygen, stomach, and urinary drainage
Water carafes

*Surgery*

Anesthesia airways
Caps
Gloves (surgical, examination)
Masks
Microtome blades
Surgical binders
Surgical blades
Surgical operating drapes
Surgical shoe covers
Surgical tubing
Suture cutter

*Trays*

Exchange transfusion
Foley catheter
Irrigation
Lumbar puncture
Spinal anesthesia
Surgical preparation
Suture removal
Urethral catheter
Venous pressure

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[40] Source: American Medical Association. Report of the Commission on the Cost of Medical Care, vol. III (Chicago: American Medical Association, 1964), p. 73.

products handled and processed by the central supply, pharmacy, laundry, and dietary departments. They represent an important source of reductions in the need for labor in such departments.

There are several reasons for the success of disposables:

1. *Patient Safety.*—The opportunity for cross-infection through reuse of articles that have been processed and sterilized improperly is virtually eliminated. Studies show that disposables often provide articles for patient care that are closer to sterile and more free of pyrogens (fever-inducing substances formed by a microorganism), than traditionally processed reusables.
2. *Patient Comfort.*—Disposables include items that cause less pain and discomfort than their reusable counterparts. Needles used for injection one time are sharper, and cause less pain, on the average, than those which are reused, even if resharpened. Disposable catheters with the same inside diameters as reusable rubber catheters usually have a smaller outer circumference, and therefore bring less discomfort to the patient.
3. *Efficiency and Economy.*—Personnel do not have to spend time in rinsing, soaking, counting, packaging, or other steps to restore items to useable condition. This is particularly important in saving the time of nurses, technicians, and other scarce personnel. In addition, economies result from eliminating the cost of materials used in reprocessing (cleaners, sterile solutions, powder for surgical gloves, etc.).

Among the most important items affected by the switch to disposables is the hypodermic needle, which requires much labor in cleaning, sterilizing, and sharpening if reusables are used. More than one-half billion procedures requiring the use of a sterile hypodermic needle were performed in the Nation's hospitals during 1963, and over 60 percent of the needles used were of a disposable type. Another important category consists of surgical trays and setups. It is believed that nearly half of the surgical trays used in 1963 were of the disposable type. Estimates on the pace of spread of disposables, among various types of hypodermic needles and some other major products, are shown in table 6.

TABLE 6. SHORT-TERM NON-FEDERAL HOSPITALS PURCHASE OF SELECTED DISPOSABLE PRODUCTS, 1958, 1960, AND 1962

[Percent]

| Product | 1958 | 1960 | 1962 |
|---|---|---|---|
| Hypodermic needles | 11.7 | 66.3 | 88.0 |
| Hypodermic syringes, without needles | (1) | 26.5 | 43.0 |
| Hypodermic syringes, with needles | 19.1 | 27.7 | 78.0 |
| Hypodermic syringe, medicated cartridge and needle | (1) | 34.9 | 46.0 |
| Sterile surgical blades | (1) | 69.9 | 85.0 |
| Plastic tubes | 78.7 | 88.0 | 100.0 |
| Surgical gloves | (1) | 38.8 | 50.0 |
| Plastic examining gloves | (1) | 21.7 | 42.0 |

[1] Not available.

SOURCE: Armbuster, Moore, and MacKerell, Inc.

The rapid progress in adoption of these items reflects readiness on the part of many supervisors in central supply to accept disposables. The trend toward disposables has not been equally rapid in the laundry and dietary departments. Use of disposable underpads for beds is widespread, but otherwise most bed linens still in use are of standard textile materials. Relatively few hospitals are using plastic dishes, but it is generally expected that their use will spread, especially because of advantages of disposable dishes in reducing cross-infection. Ultimately, hospital dietary departments may even install equipment that will stamp out dishes from plastic sheets, producing cups and plates "on demand."[41]

***Materials Handling and Storage.*** In practically every sizable hospital there is constant movement of thousands of objects throughout the day. Sterile dressings, cleaned instruments, packaged disposable products, medications, meals

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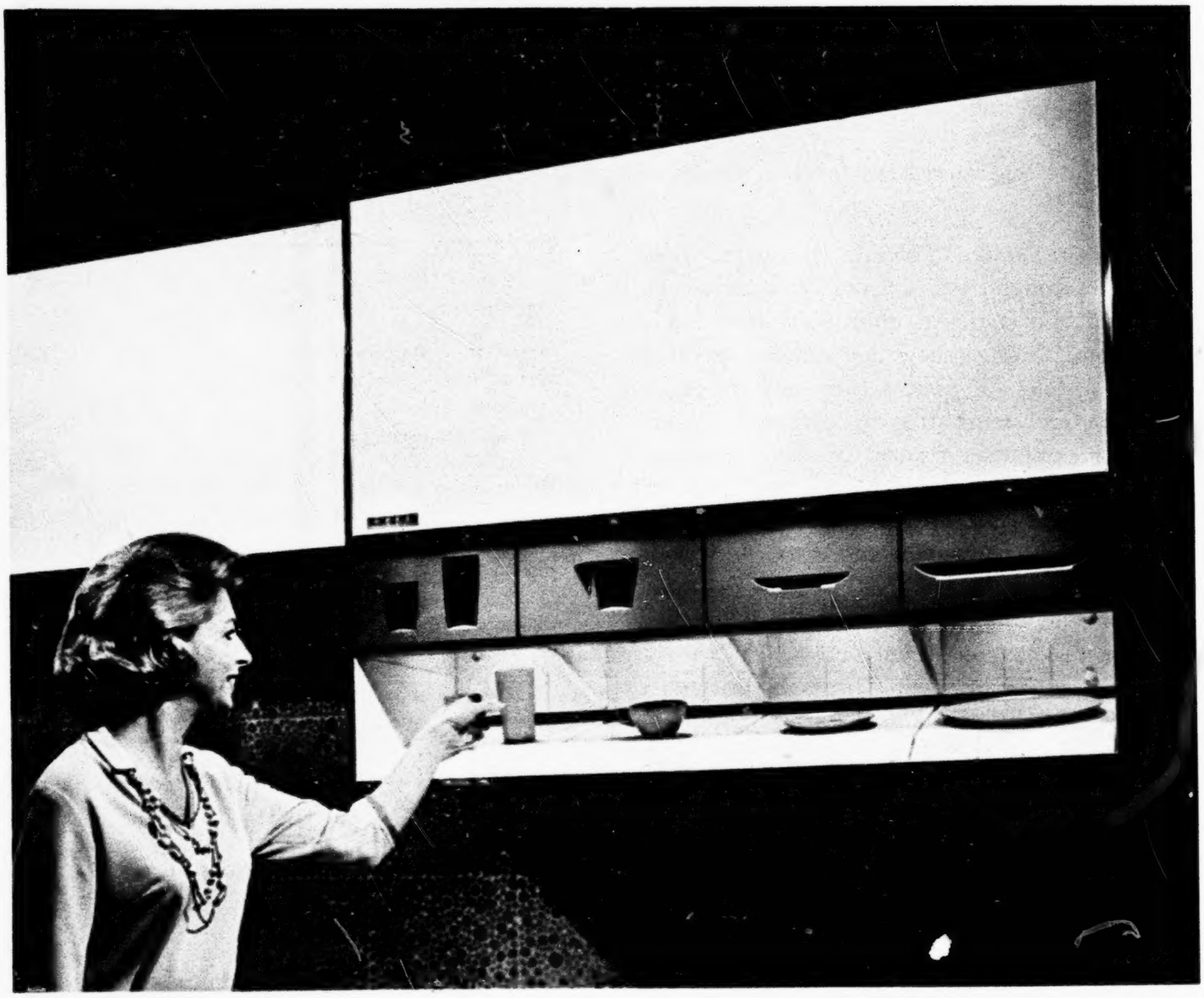
[41] Mark A. Freedman, "Unknown Usage Trends Create Hazards in Hospital Design," *Hospitals, Journal of the American Hospital Association*, December 1, 1964, p. 106–108.



*"Instant dishes" are the product of this device. Dishes are formed from large sheets of plastic, heated until it is moldable, then vacuum-formed in the shape desired.*

on trays, clean linen, and many other items needed by patients and hospital staff move steadily from the service departments to nursing units and treatment areas. In the opposite direction go the used instruments and meal trays, soiled linen, and trash, back to be cleaned, processed, or disposed of.

This constant flow requires equipment of all kinds for materials handling. In older hospital buildings standard carts, elevators, dumbwaiters, laundry chutes, and conventional airtube systems are used. Newly built and renovated hospitals use specially designed carts, automatic tube systems, and horizontal and vertical conveyor systems. (See drawing page 61.)

Such improved gear and systems not only provide greater capacity and convenience for moving materials, but in some instances produce substantial and directly evident savings in time for nurses and other personnel. For example, the modern vertical conveyor (replacing the dumbwaiter) is equipped to eject a tray or basket to a roller track at the designated floor where it can be stored and picked up at any convenient time. The modern pneumatic tube system eliminates the need for employees working at a central transfer station to redirect carrier cylinders, as required in conventional systems. Carriers can now move directly, automatically, from origin to final destination station. In hospitals that have shifted from old to modern airtube systems, the employees who had done this central dispatching work have become available for other jobs.

A hospital consultant who has emphasized the need for improved materials handling concepts in the design of hospitals, has been responsible for several innovations in supply movement and storage. Among them are the "Nurserver", and new systems for using hospital carts based on the fact that patient care requirements for linens and certain other supplies are predictable. The "Nurserver" is a two-way storage cabinet installed in every patient room. It has one set of two doors on the corridor side, another set inside the room. Half of the cabinet is for clean, sterile objects, the other for soiled objects. These cabinets permit routine supplying of patient rooms with standard quantities of linens, some medications, and other supplies, and the taking away of used materials, without requiring the supply staff to leave the corridor. Supply of patient rooms is done from the corridor side, relying on use of standardized prestocked linen and other supply carts. One or more carts is sent completely stocked to every nursing unit daily. The carts are returned to the service departments for restocking nightly. This eliminates work by the nursing unit personnel in computing what supplies need to be replenished from laundry or central supply sources.[42]

The same type of supply cart is used in place of rigid shelving to provide storage space in central supply areas. This provides advantages in mobility and flexibility within the area, and helps reduce the work in keeping stocks complete.

A further development in the use of these carts is being introduced in a California hospital—an automatic cart transportation system. This system makes it possible to lift and move carts on a conveyor or track, bringing them to a receiving station as preselected by dial. It eliminates traffic of trucks along corridors and in elevators, where the trucks compete for space with wheeled and ambulatory patients and hospital visitors and staff. This is particularly important in regard to trucks carrying soiled or contaminated materials. In addition, the personnel who previously had to push the trucks will be freed for other duties.[43]

***Communications and Maintenance.*** Various new methods of communications are being introduced into hospitals, bringing improved service and care to patients and saving staff effort. Perhaps the most useful, widespread improvement is the bedside intercom with which patients can communicate with nurses. This helps nurses avoid unnecessary trips, while patients get improved service. In many hospitals, systems are being installed for pocket-size pagers, by which nurses, doctors, and other hospital staff who must be on call (emergency aide, maintenance engineer, security guard, etc.) can be reached even when they are not at their usual stations.

Closed-circuit TV is being installed in some hospitals and is used in a variety of ways: To permit nurses to monitor disturbed or other patients who should be under frequent visual observation, to enable visiting children to talk to a parent who cannot be visited, to help in teaching medical and other staff, and for other purposes.

Another development being adopted to facilitate communication is the remote control monitoring systems for control of temperature in operating rooms and other areas.[44] Improvements in communication are particularly important in relation to engineering maintenance in large hospitals. Systems have been developed which permit one man, seated at a control center, to monitor or control temperatures and humidity and to check on fire hazards, security, and other conditions, in a large number of buildings or areas. At the console where the control engineer sits are indicators providing the control information he needs and a TV-type screen on which he can project schematic diagrams for important mechanical systems in all buildings for guidance in his control decisions. Some conditions, involving threatened or actual danger of fire or breakdown of vital mechanical systems (boilers, air conditioning, refrigeration, etc.) will turn on loud alarms.

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[42] Profile on Gordon Friesen," *Hospital Administration in Canada,* October 1961.

[43] "New Conveyor System Moves All Supplies," *Modern Hospital,* February 1965, p. 95.

[44] "Hospital Communications," *Architectural Record,* March 1962, p. 181.

These monitoring systems not only increase safety in the large hospitals in which they are installed, but also save money by increasing efficiency in consumption of fuel and electricity and by reducing labor costs for building maintenance. Substantial laborsavings have resulted from their installation. For example, at Memphis Baptist Memorial Hospital 8 jobs were eliminated, freeing men for other duties, when an early version of the system was adopted several years ago to control 10 buildings. More recently, after the hospital expanded to become a scattered complex of 19 buildings (including a satellite unit located a mile away from the main center), the maintenance monitoring system was expanded and improved. The chief engineer of this hospital has estimated that he would have had to add 16 men to his 70-man staff if the improved system had not been installed.[45]

One of the recent trends in smaller hospitals has been toward contracting out engineering maintenance services. This has always been the practice in servicing some equipment, especially if manufacturers supplying complex equipment also provide maintenance and repair services. The new trend is toward the use of a complete package of maintenance services offered by contractors who have staffs readily available to work on all basic utilities, eliminating the need for maintenance workers in the hospital's own work force.

Use of a contractor's workers instead of hospital staff is also a growing trend in hospital housekeeping maintenance. This development is partly the result of the growth of business firms which provide floor cleaning and other cleanup services to office buildings, schools, and other large structures. In many instances, these firms offer cleaning services at rates which save hospitals substantial money and enable them to reduce their responsibilities in employing maintenance forces.

Apart from this trend, some savings in manpower requirements in housekeeping maintenance has been achieved by adoption of improved cleaning equipment. Efficiency in cleaning hospital floors has improved through the installation of centrally powered vacuum cleaning systems and use of large automatic floor scrubbers and polishers. The latter are particularly effective in many of the newer hospitals in which tile flooring is widely used. There is also a growing trend toward carpeted floors in hospitals, not only in corridors, but even in patients' rooms. Some studies have shown the carpeted floors can be kept to higher standards of asepsis (using vacuum cleaning, shampooing, and cleaning with disinfectant solutions) than floors covered by vinyl asbestos tile. Moreover, the amount of man-hours needed to clean carpeted floors appear to be slightly lower than the amount to clean tile floors.

### *Improvements in the Functioning and Design of Health Facilities*

Technological advances in health service facilities differ widely in nature, ranging from the direct application of new scientific discoveries to adaptations of materials, equipment, or techniques developed originally for other industries. Among the most important categories of innovations are certain developments not always thought of as technological in nature, but certainly so considered in relation to the health service industry: Improvements in the design of physical structures, in organization for patient care, and in management methods.

Proposed improvements in the design of hospitals' physical structures are often associated with proposals for changes in their functional structure. This is not only evident in plans developed for many individual hospitals, but also in the general trend of thought among planners in the hospital field. Both kinds of improvement efforts are stimulated by the problems and opportunities that result from the availability of new kinds of equipment and by the new techniques constantly being introduced in hospital activities. Innovations in nursing care, in surgical techniques, and in the handling of supplies are among the developments that have impelled

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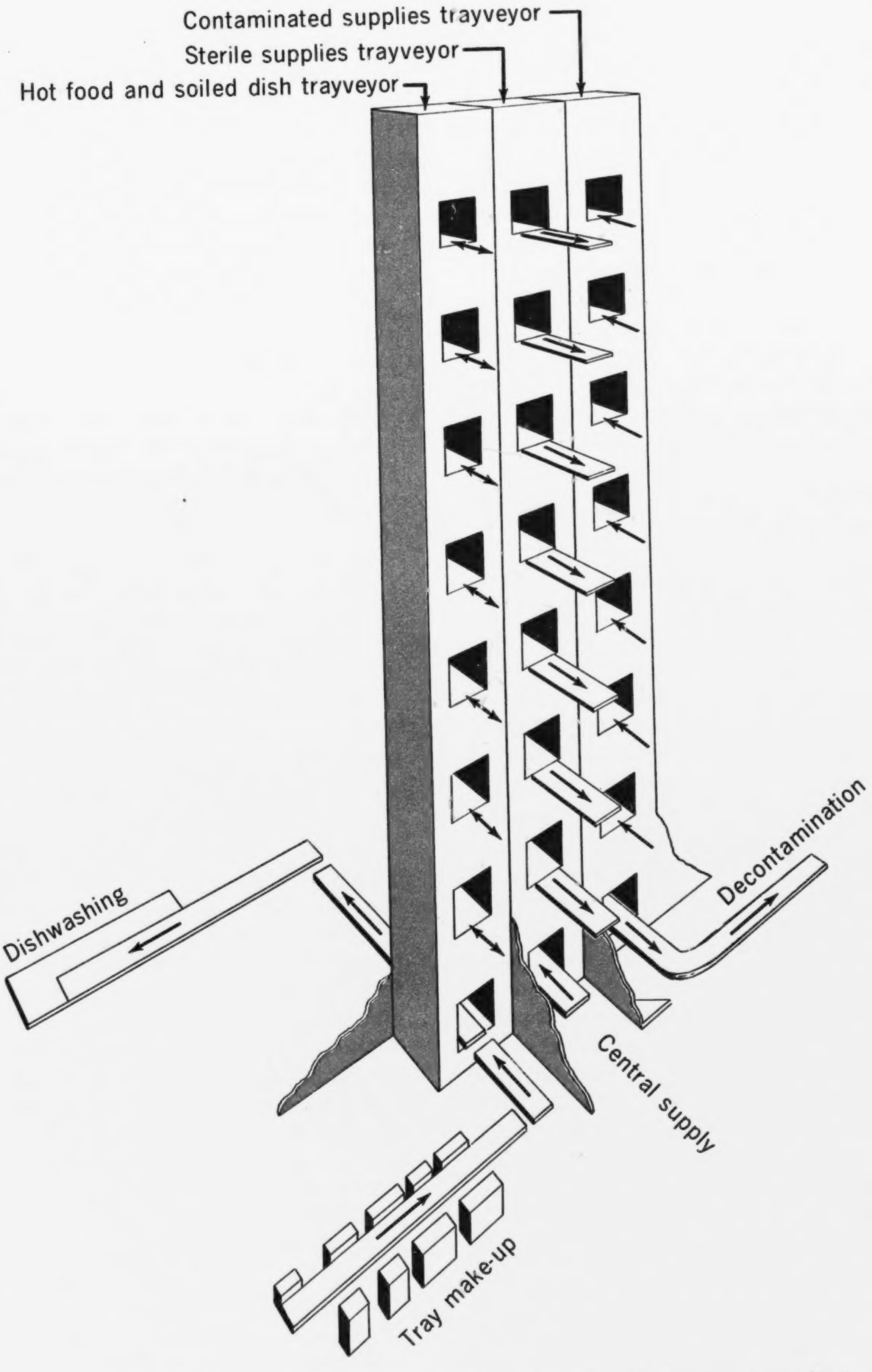
[45] "Hospital Engineer Monitors 19 Buildings," *Modern Hospital,* April 1964.


Contaminated supplies trayveyor
Sterile supplies trayveyor
Hot food and soiled dish trayveyor
Decontamination
Dishwashing
Central supply
Tray make-up

*An integrated automatic transportation system employs the concept of separate units to transport sterile and contaminated supplies. This is a central "core" type installation.*

changes in the physical and organizational design of hospitals.

***Research and Planning on Hospital Improvement.*** Many of the features of organizational and physical arrangements in today's health facilities owe their origin to reforms initiated by Florence Nightingale in the middle of the last century. Since then, many changes in organizational and structural design have occurred, reflecting contributions from the fields of medicine, nursing, hospital administration, and architecture, but up to recently the changes have taken place at a fairly slow pace.

Efforts at improving the organizational and physical characteristics of health service establishments were stepped up after World War II. The Hill-Burton program, established in 1946 to provide Federal financial aid in the construction of hospitals, stimulated new thinking on hospital architecture. An amendment to the law in 1950 recognized that the provision of structures and beds was not sufficient to assure that adequate hospital and clinic services were furnished, and authorized research, experiments, and demonstrations toward improving the services provided by hospitals. Funds under this program were not made available until 1956, but since then a number of projects related to the improvement of hospital utilization, administration, equipment, and building design have been carried out under the sponsorship of the U.S. Public Health Service. Participating in these projects have been hospitals, universities, professional associations, and other qualified groups and individuals. Meanwhile, local planning councils, medical groups, groups of architects, hospital administrators, Blue Cross officials, and consultants have been acting on their own to plan the improvement of health facilities in their areas. In 1948 a national professional organization of hospital consultants was established.

In connection with programs for building hospitals during the past 15 years, much effort has been devoted to research, not only on materials, equipment, and building design, but also on hospital organizations and management. Methods of improving efficiency in the use of manpower have received particular attention, since payrolls represent the major proportion of hospital costs. The nurse shortage, as well as the basic importance of quality of nursing care, has led to many studies and programs for improving the supervision and utilization of nursing personnel. These include shifting routine duties from staff nurses to auxiliary workers, and improving the physical arrangements of nursing units.

The scope of activities related to planning and research on hospital administration is very broad. It will be possible here to cite only a few developments of special interest from the standpoint of manpower implications.

One important development has been the appearance of agencies that provide groups of individual hospitals with research guidance, operating yardsticks, and other services aimed at raising staff efficiency and quality of performance. Some are local groups, others operate on a regional or nationwide basis. The Commission for Administrative Services in Hospitals (CASH), organized in 1963, provides a group of more than 80 hospitals located in southern California with management engineering services, paid for by a small monthly subscription fee based on the size of the hospital. The first major effort of CASH was a study of nursing service, which culminated in a program offering consultant guidance in individual hospitals for raising efficiency in nursing care. It is reported that this program has brought about substantial reductions in number of man-hours required per patient day in the participating hospitals. CASH plans to set up similar programs to cover other areas of the hospital.[46]

Another agency, which is sponsored by the American Hospital Association, furnishes yardstick information on productivity and costs to help hospitals assess their performance. The program is called Hospital Administrative Services (HAS). It services roughly 1,000 hospitals located throughout the Nation, providing highly detailed data covering activities in nearly all hospital departments. The basic reports give averages and ranges for a long list of items (such as meals prepared per man-hour, laundry pounds per man-hour, nursing man-hours per patient day). Special studies are also carried out for hospitals or groups requesting analytical information.

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[46] Robert H. Edgecumbe, "The CASH Approach to Hospital Management Engineering," *Hospitals, Journal of the American Hospital Association*, March 16, 1965.

A somewhat different service is offered by the Commission on Professional and Hospital Activities (CPHA), directed by Dr. Virgil N. Slee at Ann Arbor, Mich. This group, which is sponsored by several hospital and medical associations, supplies hospitals with a subscription service for processing their medical records, and with yardsticks needed for professional auditing of medical care. The program is referred to as the Professional Activity Study (PAS). It includes providing guidance to the hospital in the training of medical records librarians in PAS procedures, mechanical processing of abstracts of medical reports, and preparation of periodic reports printed by the computer which summarize the individual hospital's data on professional care of patients. These reports may then be compared, in reference to items of particular concern to the hospital, with averages and ranges shown by groups of comparable hospitals. Some 300 hospitals in the Midwest and Canada are participating in this yardstick program, which emphasizes factors such as length of hospital stays, and usage of X-rays, laboratory tests, surgical operating procedures, or drugs, in hospital treatment of specific conditions.

The construction and improvement of private nonprofit hospitals usually needs the support of the local community. In recent years, there has been a growing trend toward organized community participation in the planning of hospitals. This approach has emphasized identification of the unmet needs for hospital care in the community as a whole, and especially avoidance of overlaps in plans for new hospital projects, that might result from providing expensive, seldom used equipment already available in existing hospitals. When overlaps occur, the community suffers from a waste of capital funds on outlays that could have been used to get equipment or facilities actually needed. Unnecessarily high overhead costs and waste in the use of specialized manpower also result when excess capacity exists.

Growth of the community approach toward planning and coordination of health and related facilities and services has been aided by provisions added to the Hill-Burton program in 1964, which authorize grants to defray half of the costs of community planning agencies.

***Functional Concepts and Structural Design of Hospitals.*** A leading architect and hospital planner has made these observations about recent trends in architectural planning of patient care facilities: [47]

> The change from the era of long stays, bed rest, and indigent patients to the present era of short stays, early ambulation, and third-party payers has brought equally great changes in concepts of patient accommodations. The large open ward with continual visual supervision by the nurse in charge, and a small cluster of utilities for use by staff and patients, have given way to the individual room with lavatory, toilet, and sometimes shower. Visual supervision has been partly relinquished to electronic supervision . . . Importance of travel paths and distance have increased, so many plans have been developed with the aim of shortening total distances traveled when caring for patients.

Many planners have emphasized the need for close study of movements of staff, patients, and supplies in designing hospitals. The innovations which hospital consultants have introduced have included not only improved materials handling equipment, but also improved floor layouts and other features to maximize the time nurses can give to direct patient care. In many of the hospitals they have helped to design, floor layouts either omit or deemphasize the "nursing station," a feature of conventionally designed nursing units. In order to release nurses from incidental paperwork, supply tasks or related routine, and to move them closer to the bedside, these hospitals utilize a "ward secretary" to handle messages and similar work at a small administration center, and a supply technician at a supply center, on each nursing floor. Pneumatic tubes

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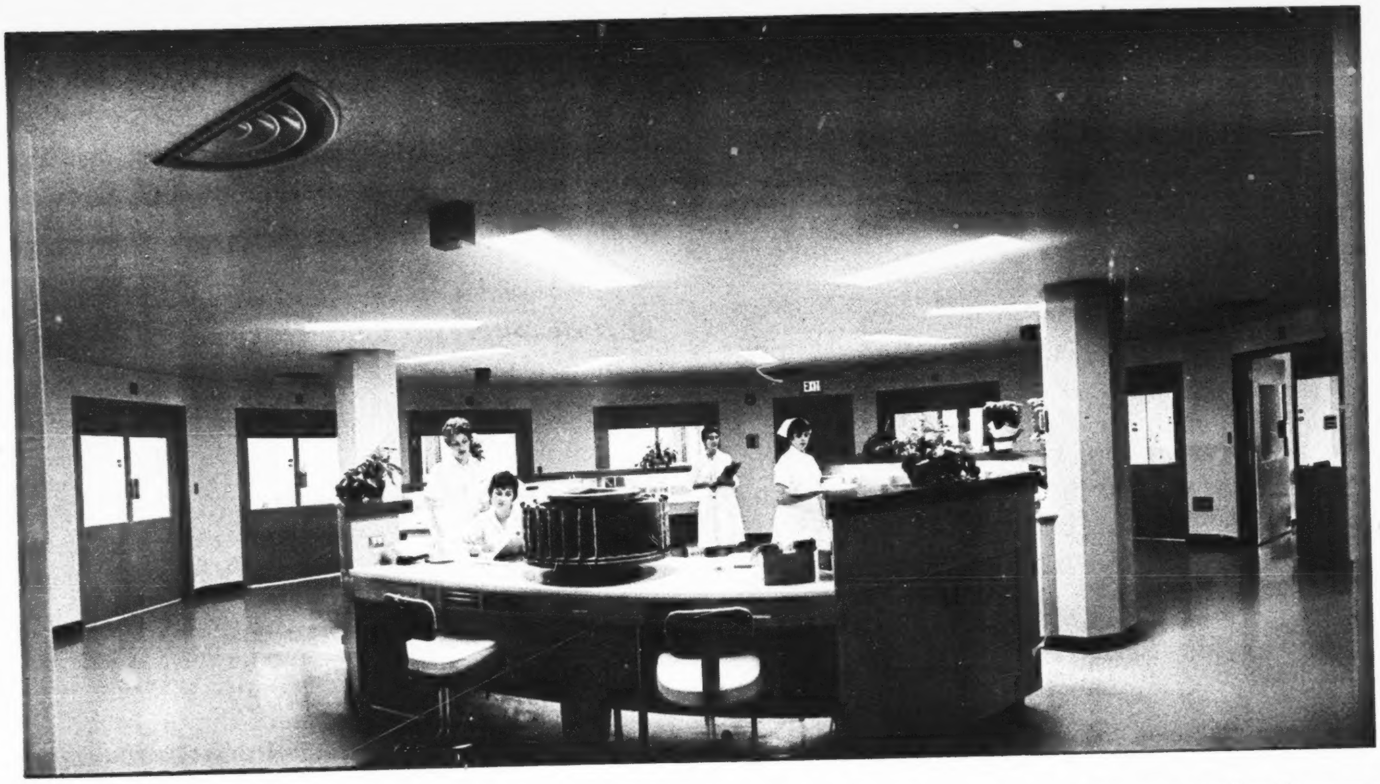
[47] Robert J. Pelletier, "Search For A Therapeutic Environment," *Hospitals, Journal of the American Hospital Association*, February 1, 1965.



*Circular nursing units reduce steps of hospital staff. The distance from the hub to any patient's room is less than 10 feet.*

*This shows an exterior view of two such units.*

and facilities for charting are provided in each patient's room. In many of these hospitals each staff nurse is supplied with a shortwave radio receiver so she can be located at any time as she makes the rounds of patient rooms. The functioning and design of a nursing unit in some modern hospitals are based on the developing three-person nursing team concept, in which appropriate duties are divided between the professional nurse (who heads the team), a licensed practical nurse, and a nurse aide. With this concept in use, the hospital may achieve optimum utilization of the skills of personnel at each level.

Emphasis on reducing the amount of walking that nurses must do has led other architects toward the use of circular nursing units. Some studies show advantages in this floor plan from reducing travel paths and providing better visual observation for nurses, but the circular plan is sometimes criticized as lacking flexibility and efficiency in other respects.

In a category by itself is the Atomedic hospital, which provides comprehensive facilities for up to 40 patients in a unique circular structure. This completely new kind of hospital is built of aluminum panels and other light structural elements that allow for easy transportation, rapid assembly, and minimum maintenance. The circular shape accommodates a central activity core surounded by 22 rooms for patients. Basic patient care equipment and supplies—sterilizers, X-rays, monitoring equipment, medication, linens, etc.—are kept in the central core. The Atomedic hospital has no space or staff for food preparation or laundering; these services are supplied from the outside. Thus far three Atomedic hospitals have been built, one in Montgomery, Ala., the other at the 1964–65 World's Fair in New York City, and one in Mexico. The design is particularly well adapted to the concept of a small satellite hospital which is autonomous for most types of general patient care, but dependent on a centrally located large hospital for specialized services.

An important trend in nursing care plans has been the development of intensive care units in hospitals for postoperative patients or other patients who may be in critical condition, such as victims of coronary attacks. In many hospitals these units are set up in the form of small open wards in which patients can be watched constantly by nurses on duty. Other types of intensive care units provide greater privacy for the patient by the use of partitions separating individual patient areas, without diminishing opportunities for close supervision by nurses.

At the opposite extreme from intensive nursing care units are quarters designed for ambulatory patients. In such units, skilled nursing care may be at a minimum. In a new unit at Montefiore Hospital in New York City, for example, meals are served to the ambulatory patient in the cafeteria, and the patient is responsible for most of his personal needs, including administering his own medication. In these units fewer hospital personnel are needed, so hospital costs to the patient are lower.

A related development is the spread of "halfway houses" for recovering mental patients. Patients living in these residences may take outside jobs and otherwise start to resume normal self-care, with assurance that trained personnel are available to give them specialized help if they need it.

The development of such new approaches to patient care, which recognize the wide range of distinct needs patients may have at different times, is associated with growing acceptance of the principle of "progressive patient care." Architectural designs growing out of this concept give examples of how the forms of patient care facilities are molded to follow their function.

The concept of progressive patient care calls for the "tailoring of hospital services to meet the patient's needs, (to place) the right patient in the right bed, with the right services, at the right time."[48] The range of approaches includes:

1. *Intensive care.*—For critically and seriously ill patients who are unable to communicate their needs or who require continuous nursing care and close observation.
2. *Intermediate nursing care.*—For (*a*) patients requiring a moderate amount of nursing care, some of whom may be ambulatory or able to participate in caring for themselves; (*b*) terminally ill patients.
3. *Self-care.*—Hospital or nursing home care for ambulatory and self-sufficient persons who require mainly diagnostic, therapeutic, or convalescent services.
4. *Long-term care.*—Hospital or nursing home care for patients requiring prolonged medical or nursing care, rehabilitative services, or aid in learning to adjust to disability.
5. *Home care.*—For persons who can be adequately cared for in the home through the extension of certain hospital services.

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[48] *Elements of Progressive Patient Care* (Washington: U.S. Department of Health, Education, and Welfare, Public Health Service, September 1962), PHS Publication 930–C1.

6. *Outpatient care.*—For ambulatory patients living outside the hospital who need diagnostic, curative, preventive, and rehabilitative services.

These different approaches may involve merely architectural modification in a single hospital structure of modest size, or they may call for differentiation of structures—either to a limited extent or in large-scale complete developments such as are envisaged in a modern regional medical center. (See drawing.)

The expanded use of hospital outpatient departments and emergency rooms by ambulatory patients reflects the spread of progressive patient care concepts. Some patients now making use of these facilities might have been bed patients under past conditions. Others might have gone to a private physician's office.

Trends toward physical centralization of arrangements for patient care are also evident in private medical practice. In the past few years, a substantial number of physicians have made arrangements for establishing offices in the hospital building. Here they can treat their private patients and have ready access to the hospital's specialized equipment. Other physicians in private practice try to locate their offices in the neighborhood of the hospitals on which they have staff connections, to assure ready access to the hospital's specialized equipment.

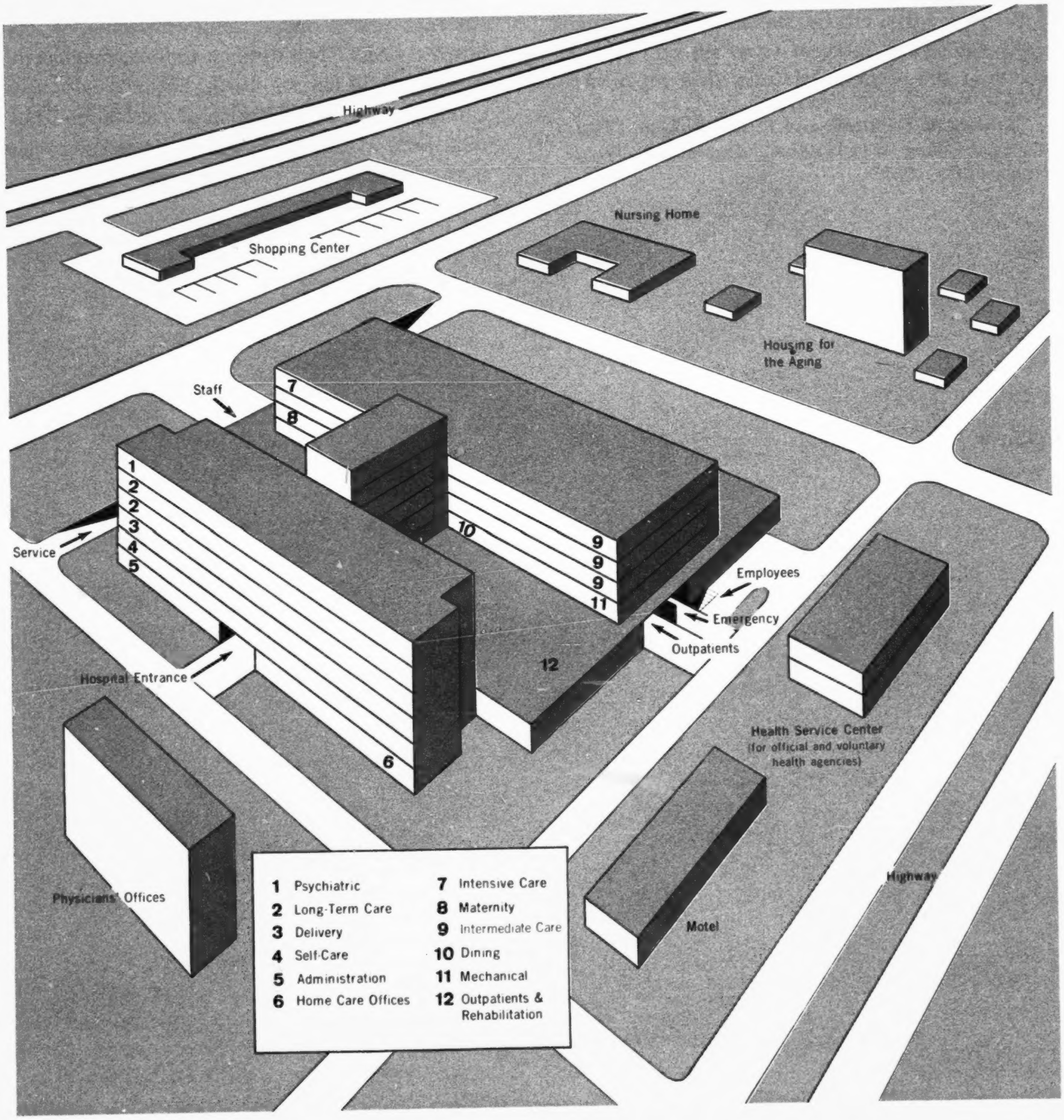
But there are also trends in other directions. Many physicians now practice with relatively less dependence on hospitals. The proportion of physicians in group practice has been rising steadily in recent years. Such medical groups tend to acquire extensive equipment, capable staffs of nursing and technical personnel, and to locate in well-designed, autonomous structures. The organization, equipment, and related arrangements in the office suites of physicians in solo or partnership practice are proportionately more modest, but are constantly being improved through efficient planning and design.

By appropriate use of equipment and staff in his own office, the practitioner of today is able to care for many more patients in the course of a day than was possible a few decades ago. The same principle has worked to greatly increase dentists' productivity. In addition to improved X–ray and drilling equipment, many dentists are making use of the services of dental hygienists who administer some dental procedures in treating patients, and of trained dental assistants who handle administrative duties.

***Effect of Design Changes on Manpower Requirements.*** The design and materials used in the construction of a health facility continue to influence the size and characteristics of the facility's staff for many years after it is built. Hospital architects are increasingly giving attention to factors which will affect the need for labor to operate the hospital. For example, some hospital designers and builders choose wall and floor coverings mainly with regard to attractiveness, sound-absorbing characteristics, or effects on asepsis. Others pay close attention to the question of ease in cleaning, because of its importance in ultimate housekeeping costs and the amount of manpower needed for maintenance.

Plans for new buildings vary from the standpoint of the buildings' adaptability to future changes in structure. In some hospitals, the question of flexibility has been a major factor in architectural decisions on materials and space arrangement. However, many hospitals are constructed with built-in equipment or other uses of space that may be useful or attractive when the hospital is built, but useless—yet difficult to alter—10 years later. In general, it is worth noting that the future pace of technological change in the Nation's hospitals will be affected by the extent to which hospital structures contain such features as adequate space for conduits to accommodate extra wiring, oxygen, or other utilities, walls built to allow for expansion or contraction of space units, and avoid building-in equipment of doubtful permanence.

Recent trends in hospital design have varying, even conflicting effects on the amount of manpower needed. Some aspects of the evolution of hospital layouts result in an increase in the number of personnel per patient, while others result in laborsaving. The trend away from the open ward, toward private and semiprivate rooms, has contributed toward increasing the personnel needed for nursing care (and incidentally, increasing costs of hospital care). On the other hand, improvements in design and equipment resulting in greater working convenience and shorter walking distance for patient care personnel have contributed toward reducing needs for staff. The net effect of changes in the use of hospital structures up to recently has probably been to increase demands for personnel per patient. Eventually, this will be offset by the emphasis on laborsaving evident in many new hospital designs. In new hospitals by one designer, for example, the ratios of personnel per patient have been substantially lower than the national average of 2.4 for short-term general hospitals. At Holy Cross Hospital, San Fernando, Calif., the ratio is 1.7; at Carroll County General Hospital, Westminster, Md., it is 1.4.


Highway
Shopping Center
Nursing Home
Housing for the Aging
Staff
Service
Hospital Entrance
Employees
Emergency
Outpatients
Health Service Center (for official and voluntary health agencies)
Physicians' Offices
Motel
Highway
1
2
2
3
4
5
6
7
8
9
9
9
10
11
12
1 Psychiatric
2 Long-Term Care
3 Delivery
4 Self-Care
5 Administration
6 Home Care Offices
7 Intensive Care
8 Maternity
9 Intermediate Care
10 Dining
11 Mechanical
12 Outpatients & Rehabilitation

*The regional medical center provides a wide spectrum of services and facilities for both the inpatient and outpatient. (Source: Department of Health, Education, and Welfare.)*

An even lower ratio—less than 1.0—is reported at the circular Atomedic hospital, but this reflects partly the fact that several services at this hospital are performed by outside contractors.

A renovation and addition to St. Luke's Hospital, St. Paul, Minn., completed in 1963, provides an example of significant savings in the amount of manpower needed because of the use of circular design. Figures on nursing personnel required showed that the new circular design units required 22 percent fewer nursing personnel than the rectangular units they replaced.[49]

Since many technological developments are more likely to be incorporated in new than in older hospitals, the Nation's future demand for health manpower will be influenced by the pace at which its hospitals are being built or renovated. The Hill-Burton program and other factors have kept hospital building at a high level in recent years. But the number of hospital beds in obsolete hospitals being replaced by new facilities each year is only a small proportion of total hospital beds. It is difficult to forecast what the turnover will be by 1975, but it is doubtful whether more than a fourth of the Nation's hospital beds at that time will be in hospitals less than 10 years old.

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[49] Dennis R. Sohlstrom and Russell Sudeith, "Technological Change in a Hospital," *Employment Service Review,* May 1965.

# 3

# Outlook For Health Manpower, 1965–75

Preceding chapters have dealt with basic characteristics and recent trends affecting health facilities and health manpower, and with the changing technology of the health service industry. This chapter examines the trends and changes that may be expected during the next decade and their implications. It gives projections to 1975 of manpower requirements in the major occupation groups, and discusses the changes in work content likely to affect particular health occupations. On this foundation, some conclusions are drawn concerning efforts needed to adjust the supply of health manpower to meet future demands.

The number and kinds of manpower that will be required in health service establishments in future years depend on three interrelated factors: (1) The total demand for health services that may be expected—which will be influenced to some extent by basic factors such as the birth rate and the general health of the population, but more substantially during the next decade by the ability and willingness of families and governments to spend money on health care; (2) the anticipated nature and composition of health service facilities and activities, which especially refers to expected shifts in importance among types of services that will be required—e.g., growth in use of nursing home beds in comparison with use of hospital beds, increased use of drugs in treatment of mental illness (and consequent reduction in average hospital stays), etc.; (3) productivity trends, as they vary in particular kinds of health facilities and activities—that is, the changes in the ratio of output (as measured in units of health service performed) to input (as measured by man-hours), both in the purpose and functioning of the health service industry as a whole, and in specific activities, such as childbirths, appendectomies, laundering, serving meals, and other elements of workload.

Expectations regarding trends which reflect these three factors are summarized below. They provide a framework for projecting manpower requirements among occupation groups in the health service industry during the next decade.

## *Expected Trends in Demand and Productivity Affecting Health Jobs*

The following expectations affecting future trends in the amount of manpower required in the health service industry appear reasonable:

1. *The total demand for health services in hospitals, nursing homes, and other health facilities will increase between 1965 and 1975 at rates moderately higher than those of the recent past.* This increase will result from rising personal incomes and increased desire for health care on the part of consumers and public authorities, which will lead to higher expenditures for health and continued growth of programs such as Medicare and other health programs being provided by new legislation.

The rate of increase in the total demand for health services (whether expressed in terms of dollars or man-hours) will depend partly on the composition of demand among the different components, i.e., facilities and services. Activity in some facilities may rise rapidly in the next year or two, but this will not necessarily mean that the trend in total demand for patient care for the whole decade 1965–75 will rise sharply above the trend for the past decade. A moderate rise over past trends may be expected, reflecting the start of the Medicare programs, which provide benefits to aged people that are, as yet, limited in scope and duration. The beginning of operations of the two main parts of the program in July 1966 and January 1967 may bring a surge of applications in some localities by aged people immediately in need of care (some of whom had been deferring needed surgery or other treatments until they could obtain benefits). But after the initial group of Medicare applications has been handled, the total demand for health care during ensuing years will probably be only moderately higher than during the past decade—unless the Medicare program is expanded through new legislation.

2. *The relative importance of various types of health care facilities and activities will show significant shifts between 1965 and 1975.* Available data and informed judgments suggest that the total number of hospital beds is likely to grow to about 2 million in 1975, from about 1.7 million in 1965. Most of the increase will occur in short-term general hospitals. A sharp increase may be expected in the number of beds in nursing homes, estimated at 500,000 in 1965. By 1975, they will possibly number 1.2 million, exceeding the number of beds in short-term hospitals.[1] (See chart 6.)

The growth in number of nursing home beds by comparison with hospital beds will be accompanied by other changes in the composition of health facilities. Outpatient departments of hospitals will expand. The number of outpatient visits in hospitals is likely to increase to over 180 million in 1975, 50 million more visits than in 1965. Hospital home care programs, which up to recently had been provided in only a few hospitals, are likely to be established on a wide scale under the impetus of the Medicare programs.

The increase in the importance of nursing homes, hospital outpatient care, home health programs, and related programs of progressive patient care will probably result in substantial lowering of the average requirement for paid time of employees in the health service industry as a whole to care for cases. Only about a fourth as much employee time is required to care for a patient in a nursing home as is needed, on the average, in a short-term general hospital. Cases handled in home care programs probably will also require a relatively low amount of employee time. Still less employee time may be needed for patient care in expanded outpatient programs. These reductions in man-hour requirements per patient case will perhaps be offset by a temporary increase in the employee/patient ratio for bed cases handled in short-term general hospitals

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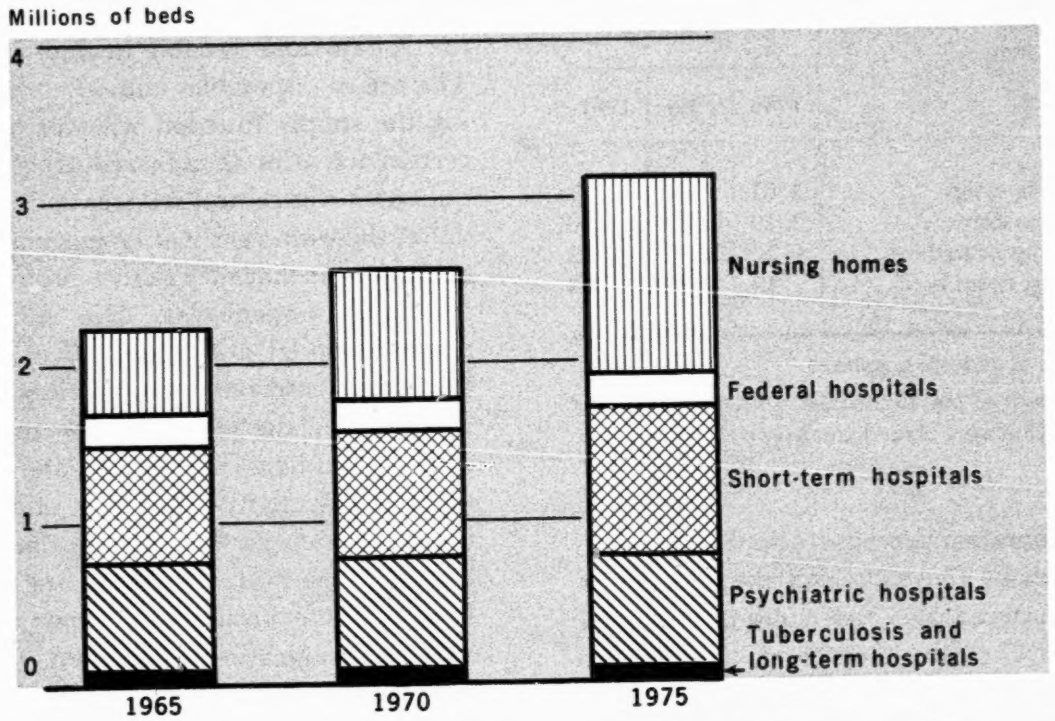
[1] These projections of number of beds in hospitals and nursing homes are based on various sources of information and opinion, including estimates in "Hospitals—Retrospect and Prospect," by John R. McGibony, M.D. (*Hospitals, Journal of the American Hospital Association*, October 16, 1964), data from surveys by Public Health Service and the American Nursing Homes Association, and opinions on the future effects of Medicare programs expressed by officials of the Department of Health, Education, and Welfare, the American Hospital Association, and other professional associations.

Chart 6. Number of beds is rising faster in nursing homes than hospitals.



Source: Estimates, U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research. (See app. table C-5.)

early in the decade, but eventually the net effect of shifts in the composition of facilities used and on manpower requirements in the health service industry is likely to be downward, reversing the trend of the past decade.

The increased importance of extended care and related facilities for health care, such as nursing homes, outpatient care, and home care, will have significant effects on manpower requirements. In general, they will result in some emphasis on needs for professional and other trained personnel—especially registered and practical nurses and technicians. They will also provide many jobs for aides, attendants, laundry and dietary workers, including the practically new category of "home health aides."

The growth in the number of patients in nursing homes will be a significant factor contributing to a rise in demand for professional and practical nurses. During the last few years, an increasing number of state authorities that regulate nursing homes have required that at least one professional nurse be on the staff before a home is considered as meeting adequate skilled nursing standards. This trend is likely to continue. Another important factor working in this direction will be the Medicare programs' requirement that acceptable nursing homes have a full-time professional nurse on the staff, and provide 24-hour nursing service by professional or practical nurses.

Growth and changes in trends relating to the character of medical and other health treatment required by patients will also affect the number and type of health workers in various ways. Past trends in utilization of certain clinical services are shown in table 7. These indicate the number of specific categories of services provided, per hospital admission, in 1946, 1954, and 1961 in a representative sample of short-term hospitals. In 1961 diagnostic X-rays per patient reached a level three times as high as it had been

Table 7. TRENDS IN UTILIZATION OF SELECTED HOSPITAL ITEMS AND SERVICES: RATIOS PER HOSPITAL ADMISSION,[1] 1946, 1954, AND 1961

| Item | Ratio of utilization per admission [1] | | |
|---|---|---|---|
| | 1946 | 1954 | 1961 |
| Different generic drugs | 4. 67 | 5. 97 | 7. 30 |
| Laboratory procedures | 3. 19 | 4. 32 | 6. 36 |
| Diagnostic X-ray procedures | 1. 50 | 3. 16 | 4. 42 |
| Times operating room used | . 49 | . 46 | . 43 |

[1] In a sample of general hospitals.

SOURCE: *Report of the Commission on Cost of Medical Care*, vol. I (Chicago: American Medical Association, 1964), p. 148.

in 1946. Laboratory procedures doubled in number during these 15 years, and the number of drugs administered also rose substantially over this period. On the other hand, there was a slight decline in use of the operating room.

Looking toward the future, it seems safe to predict on the basis of these and similar data that the use of X-ray and laboratory staffs and equipment and the number of new medications administered will continue to rise sharply.

It is doubtful that the frequency of use of surgery will decline, i.e., that the 1946–61 trend will continue. It seems more likely that use of the operating room will increase in the period ahead, in view of an expected rise in the birth trend and the development of new advances in surgical techniques—in treating cardiovascular impairments, utilization of artificial body parts and other prosthetics, implanting electronic devices and transplanting organs, and other techniques. Demands for specialized professional nurses will be intensified, not only because of the importance of nurse specialists as assistants in operating room procedures, but also because more use of surgical procedures will result in increased need for postoperative nursing care of patients in intensive patient care units.

3. *Productivity in the health service industry will improve during the decade 1965–75.* Changes in technology affecting specific functions of hospitals and other health facilities will increasingly improve productivity, lowering man-hour requirements per unit of service provided. Automation in the clinical laboratory will spread, reducing the labor requirements for many tests. Man-hour requirements per unit will also decline for X-rays and related diagnostic procedures. The use of disposables and other changes affecting the supply function will not only eliminate certain activities, thereby reducing man-hour requirements in central services and in the nursing units; these changes will be especially significant to the extent that they release professional nurses for bedside patient care. The rise in awareness among hospital administrators of potentialities for payroll and other cost savings are likely to result also in the installation of improved information handling equipment, and adoption of other productivity-promoting innovations, in functions such as food service, laundry, housekeeping, plant maintenance, and office work. Increased use of improved materials handling and communication equipment will result in some productivity gains. Among innovations, perhaps the most substantial potential source of productivity gains that will be translated into savings in hospital manpower will be the computer—but it is not likely that its effects on productivity trends in the health service industry will be felt significantly until after 1970.

The demand for labor in hospitals will also be eased, as time goes on, by the tendency of hospital administrators to rely on contractors or suppliers outside the hospital to carry out certain functions. These include: Laundry service, housecleaning, food service, and processing of business and medical records. Available data indicate that fewer than 5 percent of hospitals currently use outside contractors for these services, but by 1975 perhaps 1 in 10 hospitals, if not more, will rely on outside firms to handle these functions or parts of them, as a means of improving productivity in hospitals.

It is not possible to estimate directly the effect of productivity improvement resulting from technological change on the future need for workers in the health service industry, because of lack of adequate data for measuring productivity. However, the combined effects of shifts in demand for patient services and of technological improvements are broadly reflected in data on the employee/patient ratio in health facilities. These figures have been used to aid in projecting total manpower requirements in the health service industry in 1975, as described in a note on productivity projections in the Statistical Appendix. The projections of manpower requirements are presented in the section that follows.

## *Employment in Health Occupations 1965–75*

Ten years from now, employment in the health service industry will have expanded greatly. The number of jobs that will have to be filled cannot be predicted accurately, but available information provides a reasonable basis for outlining broadly what health manpower requirements are likely to be. Estimates of employment (i.e., number of filled jobs) in major occupation groups in the health service industry in 1965, 1970, and 1975 are presented in table 8. These are based on estimates of 1965 employment in major occupation groups previously presented in table 2.

The projections in table 8 should be considered to represent expected orders of magnitude rather than precise figures. They were developed by translating into numbers of full-time equivalent jobs the effects of expectations regarding growth and change discussed in the previous section—demand for health services, productivity and technology, and related factors affecting employment in health service establishments. The expectations were based partly on statistical evidence, partly on factual data, somewhat on subjective judgments. The numbers of jobs projected on the basis of these expectations, as shown in table 8, likewise had to be estimated by using a mixture of statistical calculations, expert opinion, and ordinary judgment. The methodology used in deriving the projections is discussed in the Statistical Appendix, which provides a detailed analysis of concepts and data related to productivity and demand factors.

The projections in table 8 suggest that full-time equivalent jobs in the health service industry may rise from 2.7 million in 1965 to 3.1 million in 1970 and 3.6 million in 1975. This implies an overall percentage increase of employment in the health service industry of 33 percent from 1965 to 1975. This expected rise in employment in the health service industry will be paralleled by increases in the total number of persons engaged in health activities. (See chapter 1 for estimates of the number of persons in health occupations outside of the health service industry as defined here.)

The rate of employment growth will be higher in the first half than in the second half of the decade. Over the whole 10 years, employment growth is likely to occur at an average rate slightly lower than was experienced during the decade before 1965. As indicated in the appendix note on productivity, during the past 10 years many factors contributed to an increase in hospital employment at a faster rate than the rise in the patient load. During the 10 years that lie ahead, however, total labor requirements will probably grow less rapidly—mainly because of the growth

Table 8. Estimated Employment in Health Service Industry, by Occupation Group, 1965, 1970, and 1975[1]

| Occupation group | Number of employees (thousands) | | |
|---|---|---|---|
| | 1965 | 1970 | 1975 |
| Total employment | 2, 700 | 3, 150 | 3, 600 |
| Administrative and office | 500 | 570 | 600 |
| Dietary personnel | 235 | 265 | 295 |
| Laundry, housekeeping, and maintenance | 280 | 320 | 345 |
| Medical laboratory personnel | 100 | 130 | 160 |
| Medical records personnel | 35 | 39 | 42 |
| Nursing personnel | 1, 200 | 1, 415 | 1, 700 |
| Pharmacists | 11 | 12 | 13 |
| Rehabilitative and other technicians | 120 | 150 | 185 |
| X-ray technologists | 30 | 40 | 52 |
| All other employees | 189 | 209 | 208 |

[1] Employment expressed as full-time equivalents.

Source: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research. (See text and Statistical Appendix.)

in relative importance of facilities requiring relatively less labor, such as nursing homes and outpatient services. In some individual types of facilities and in some occupations, the number of jobs will grow more rapidly than ever before, but in others, employment growth will taper off as 1975 approaches.

### *Expected Differences Among Occupation Groups*

The greatest expansion in number of jobs in the decade ahead will probably involve the X-ray and clinical laboratory departments. Jobs in these areas are likely to expand twice as fast as jobs for health service employees in general, mainly because of the sharp increases in use of X-ray techniques and clinical laboratory testing during the next 10 years. Rising demands for employees in these departments will be only partly offset by the spread of automated laboratory equipment and improved X-ray equipment. Increases in number of jobs for nursing personnel and rehabilitative and other technicians will also be above average, chiefly as a result of improvements in surgery and other clinical techniques requiring intensive care of patients by qualified paramedical personnel.

Employment expansion between 1965 and 1975 will probably be slower among these groups: Medical records personnel; dietary personnel, laundry, housekeeping, and maintenance personnel; administrative and office personnel; and pharmacists. The growth in jobs among these groups will tend to decelerate in the latter half of the decade, when laborsaving effects of productivity improvements are likely to have noticeable impacts.

Some of the variations likely to affect employment levels do not show up as clearly between these broad occupational categories as they would if comparisons were available for specific occupations within groups. There will be very sharp increases in numbers employed in some individual occupations and significant declines in others in various groups.

But it would be very difficult to anticipate trends in employment for more than a few individual occupations 10 years ahead. Apart from data limitations, a main obstacle is the fact that persons trained for occupations at low levels of skill have been used, and undoubtedly will continue to be, to fill higher level health service jobs. In the nursing personnel category, for example, staffing patterns have frequently varied in accordance with changing local supply-demand conditions. In many hospitals, during emergencies nurse aides have had to be substituted for practical nurses and licensed practical nurses have filled in for professional nurses. In spite of efforts to increase the supply of professionally trained nurses, it seems likely that such practices will continue. The proportions of professional and practical nurses among the total nursing personnel group may therefore either decline or increase in prevalence during the next 10 years; it is difficult at this point to say which is more likely.

***Implications of Technological Changes on the Job Outlook.*** The health service industry will provide expanding work opportunities to men and women at all levels of age and educational attainment, in practically all areas of the country, during the next decade. A constantly increasing proportion of jobs in the health field will require years of initial training, but this will not mean that opportunities for the less educated jobseekers will shrink. Thousands of workers will be needed in jobs calling for low levels of skill, for a long time to come, as a result of growth and of usual labor turnover. The technological changes in hospitals and other health facilities that will have the effect of reducing or eliminating needs for workers with limited skills are likely to be adopted at a pace slow enough to leave time for adjustments in the form of retraining programs and transfers to other jobs.

A summarized statement comparing the various effects that major technological developments will have on health manpower is given in exhibit 5. Included are laborsaving, labor-demanding, and job-altering effects. Some of the innovations referred to, such as automated laboratory equipment, are already having significant laborsaving effects. But even though automation in the laboratory will be spreading rapidly during the next decade, the still more rapid increase

EXHIBIT 5—MANPOWER ASPECTS OF MAJOR DEVELOPMENTS IN HEALTH TECHNOLOGY [2]

| Innovation | Status of spread in 1965 | Expected pace of spread, 1965–75 | Manpower effect |
|---|---|---|---|
| Automated lab equipment. | Some available in *most* large hospitals and labs. | Rapid. | Labor*saving*. |
| "Disposables". | Some used in *most* hospitals | Rapid. | Labor*saving*. |
| New advanced surgical techniques, equipment, etc. | Some types available in *some* large hospitals. | Moderate. | Labor *demanding;* changes in skills and jobs. |
| Use of computer. | Limited applications, in few hospitals. | Slow until 1970; moderate, 1970–75. | Labor*saving;* some new jobs. |
| Management improvement programs. | Beginning to spread. | Slow until 1970; moderate, 1970–75. | Labor*saving*. |
| Advanced hospital design. | Relatively few hospitals. | Slow. | Labor*saving*. |

in the volume of laboratory tests required will make it unlikely that automation will cause any laboratory workers to lose their jobs. The other major innovations in patient care facilities that have laborsaving effects are likely to spread slowly, without materially diminishing the demand for workers, until perhaps the latter half of the decade.

Since the general effect of innovations in the health field is primarily to raise the quality of health care, they tend on the whole to increase the demand for manpower trained in new skills rather than reduce the demand for labor. They not only create new kinds of jobs, but broaden existing jobs by requiring them to incorporate new skills. The computer is an example of an innovation that will have several effects: Broadening the jobs of laboratory workers, nurses and others; bringing a new category of electronic data specialists into hospitals; and eventually also effecting substantial laborsavings among clerical and related other groups, which may reduce their proportions among the hospital labor force.

It is conceivable that new health technologies could spread at a pace faster than the trained people needed to man them could be developed, but this does not seem likely to occur. The pace at which pending major innovations will be introduced appears likely to be moderate enough. If the existing urgent problem of shortages of trained health manpower can be solved in the next few years, by training and developing the large numbers of manpower now needed in traditional health jobs, it should not be hard to train as many people in the use of new techniques as will be needed by the actual adoption of innovations, without unusual efforts on the part of training authorities. Special efforts will be needed, of course, if programs are adopted for spreading certain specific new health technologies. If a policy decision of the Federal Government were to call for fast action to set up a fully adequate network of kidney dialysis centers, for example, throughout the United States, top priority would have to be given to a program for accelerated training of thousands of medical and paramedical specialists in artificial kidney machine procedures.

## *Limitations of Projections*

The rates of growth shown by the projections presented here reflect the fact that they are based on a specific definition of health manpower. (See chapter I.) That is, the estimated growth in employment shown for nurses and technicians for example, does not reflect the growth in numbers of these workers expected in schools, independent practice, etc., or other employments excluded from the definition of health service employment used here. Projections of total employment in the health field or employment in individual occupations based on other definitions would probably show different rates of change even if they were derived from the same assumptions and estimating procedures.[3]

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[2] Source: U.S. Department of Labor; Manpower Administration; Office of Manpower Policy, Evaluation, and Research.

Another aspect of the projections related to the definition of employment used which should be borne in mind involves the fact that only government-operated hospitals and nursing homes are included here. Other government health service activities are omitted. Looking to the future, it is possible that new government-sponsored activities for providing health services through the employment of disadvantaged persons may ultimately furnish a significant source of demand for health manpower. For example, home health care services provided by Federal and State agencies (such as those sponsored by the Office of Economic Opportunity) or by other agencies in local communities, may grow in importance as a result of the changing pattern of health services being brought about by the Medicare program and other new developments. In addition to such programs, efforts at greater (or less) use of the labor of other persons not included in employment figures, such as hospital patients and unpaid volunteer workers, may affect future requirements for health workers in low-skilled categories.

Aside from the definitions on which the projections are based, other limitations should be mentioned.[4] The reliability of the projections is affected by the fact that there are gaps in data on certain important areas. Among subjects on which there is a lack of up-to-date, reliable information are: The number of skilled care nursing homes and their bed capacity and employment; age, description, and rate of replacement of hospital structures and equipment; quantitative data of various kinds on the spread of new technological developments in health facilities; productivity data, in terms related to trends of output per man-hour in hospitals. Such data need to be developed. Until they become available, projections of the amount and kinds of manpower needed will continue to be very uncertain.

Lack of such data is one of the reasons for the omission from this study of projections for individual occupations within the occupation groups. Such data are needed for making the kind of reliable projections required to plan training programs for specific occupations.

It should be mentioned that for purposes of planning manpower development programs, the projections furnished here need supplementation in another important respect. As estimates of employment (full-time equivalent) they show expected increases in the number of jobs that will need to be filled. To plan training programs, it is necessary to anticipate the total number of persons (full- and part-time) who will enter these jobs in the future—not only those needed to fill new jobs, but also replacements for any workers who are separated. This requires estimates which include projections of turnover rates among various occupations, for it will make considerable difference in an estimate of the number of trainees needed in the future if it is assumed that employees will stay in a particular occupation 20 years, on the average, as compared with an expectation that they will stay in their jobs 2 years. Such projections would have to take into account such factors as expected changes in wage levels, or related factors which could induce already trained people to stay on the job or to attract those who have previously quit to return to work. This would raise questions concerning which, at present answers, can only be guessed.

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[3] The expected rate of growth in employment in the "health service industry" indicated by these projections (full-time equivalent) is lower, for example, than projections of the total number of wage and salary workers in SIC 80.—Medical and Other Health Services (see Statistical Appendix).

[4] It should be noted that the projections of employment shown in table 8, as the probable number of actually filled jobs (in terms of full-time equivalents) are lower, in almost all occupation groups, than the numbers of workers that would be estimated as the *need*. The figures shown are based on an assumption that recent and current trends and conditions affecting health service employment will continue, especially in regard to: (1) Fiscal capacity of the facilities (affecting their ability to hire enough people at sufficiently attractive pay); (2) training output capacity of the health manpower training system (including its capacity to attract enough trainees, through programs of loans, scholarships, and stipends, etc.). If assumptions were made providing for new programs of operating subsidy payments to hospitals, and for loans, scholarships, and other training incentives, estimates according to the concept of "actual" employment would have to be revised, and would approach those that would be made according to agreed standards of "needs."

For example, does it seem likely that in the next few years a stepping-up of minimum wage protection will occur, completely removing the differentials now affecting health service employees by comparison with other workers? If so, a general rise in the wage structure of the health service industry would ensue, since a raise in the pay of lower skill categories is likely to result in upward adjustment in the salaries paid to higher skill groups. Labor turnover among hospital employees would probably decline, some health service workers who had quit would return to jobs in health facilities, and the number of persons who will need training in health occupations would in this case be smaller than otherwise. On the other hand, if increases in minimum hourly wages remain insufficient to close the gap between earnings in health service and other industries, it is not likely that they will affect the supply of health manpower significantly.

## *New and Changing Occupations*

Advances in medical science and health technology are bringing about constant change in the kinds of work done by health workers and the emergence of many new jobs. Such changes are altering traditional occupational patterns in the health service industry.

Some of the new jobs added in a large number of hospitals include: Inhalation therapist, prosthetic (or orthopedic) technician, medical emergency technician, surgical technician, blood bank technician, medical electronic engineer, electronic instrument technician, ward secretary (or floor manager), ward supply technician, and electronic data processing and maintenance specialists of various kinds.

A typical example of a rapidly growing specialized job is that of the inhalation therapist. This occupation has recently been added to the group of technicians for which training is regulated and approved by the American Medical Association and associated professional associations. So far, seven schools have been approved to give this training. Training for other specialties (prosthetic technicians and medical emergency technicians) is given in some junior colleges, as well as in on-the-job courses.[5] Training for the other jobs mentioned is available either in institutional courses or in on-the-job training.

Surgical technicians may already be found in many hospitals, working together with professional nurses who are operating-room specialists. These technicians are either licensed practical nurses trained in "scrubbing" or unlicensed personnel who "picked up" their skill in the Armed Forces or who were trained on the job in a hospital. A division of the American Hospital Association is currently developing training programs in a related specialty called surgical technical aide (operating-room technician), under arrangements provided by an on-the-job training program contract with the U.S. Department of Labor.

Among new jobs likely to become more and more prominent in the health service field during the next 10 years will be those related to the spread of the electronic computer and the use of other electronic devices. Eventually, many jobs will become available in hospitals for programers, systems analysts, console operators, card-punch (or other input machine) operators. Many other positions will open up for highly trained medical electronic technicians and medical engineers who will be needed to meet requirements for on-the-spot availability of specialists to repair, modify or design equipment. Most of these jobs will be set up on hospital staffs, but some of them will be filled by employees of firms offering contract services to hospitals.

Changes in the content of old-line health service occupations follow characteristic patterns which differ from one job to the next. One pattern is illustrated by the impact of automated equipment in the clinical laboratory. Medical technologists who previously had spent most of their time conducting simple tests by manual methods are now able to set up machinery for doing a large number of such tests at once, or to supervise assistants in doing this; they themselves are freed to do more complicated tests or to conduct research. In this case, technological change has taken routine and drudgery out of the job of the professional worker, shifting it to the machine. Somewhat different patterns are followed in the application of other innovations. For example, to utilize specialized equipment such as artificial kidney machines, inhalation therapy equipment, or physical therapy devices, nurses or other trained health workers must either learn their functions and incorporate them in the general range of skills they use, or they may turn them over to other people who acquire training in the new specialties.

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[5] Robert E. Kinsinger, *Education for Health Technicians, An Overview* (Washington: American Association of Junior Colleges, 1965).

The continuing spread of technological innovations in the health field will always offer new challenges, as well as opportunities, to professional groups, especially to nurses. In past years, the introduction of new devices in the hospital often resulted in the nurse's learning to use them as the doctor's assistant. Many years ago, the nurse was responsible for many other duties, which since have been taken over by specialists—X-ray operation, laboratory testing, electrocardiography, dietetics, medical social work, medical records maintenance, physical and occupational therapy, health education, and others. In recent years, the development of new specialties such as inhalation therapist and surgical technician illustrates that this process is continuing. A question that constantly arises is: Which specialized areas should be retained by the nursing profession as it continues to evolve under conditions of advancing health technology?

Dr. Mark Blumberg of Stanford Research Institute, who has pioneered in analyzing the implications of technological advances in the hospital field, has this to say about the question: [6]

> The answers will probably have to come from professional nursing itself. Most of the technical patient care services that professional nursing has already abandoned have not been beyond the physical or intellectual powers of nurses, nor are most of the devices of the future likely to be clearly beyond nursings' scope. The answer seems rather to be based on whether or not professional nursing can come to accept specialization among hospital nurses as necessary and worthwhile. . . .
>
> Physicians recognize nurses' special abilities; witness the neurosurgeons and orthopedic surgeons who have their own scrub nurses travel with them when they are required to operate in several hospitals. Pediatric nursing, obstetric nursing, and psychiatric nursing are tacitly recognized as clinical specialties within the area of hospital nursing. . . .
>
> The professional nursing postgraduate educational system is not geared toward this kind of specialization, but rather toward specialization based on the number of years spent in college and the level of the nursing degree. A master's or doctor's degree in nursing education, to my mind, provides no better educational basis for a professional nurse to serve on a hyperbaric care unit, a coronary monitoring unit, or an artificial kidney unit in a hospital than does the education of a nurse without such academic degrees. It would seem that the only fair measure of a professional nurse's ability to handle these specialized responsibilities would be specialized training and experience in such units. . . .

These problems are facing the nursing profession at a time when many related questions affecting the future development of nursing and nurse training need to be answered and when the shortage of professional nurses is steadily growing more critical. The shortage of nurses seems likely to accelerate splitting off of specialized duties from the nurse's jurisdiction, causing the assignment of these tasks to a growing list of technicians trained in particular new techniques.

The changing character of health occupations and the proliferation of new health service jobs, complicates some of the problems of planning to meet current and anticipated shortages of health manpower—especially to the extent that they call for personnel with years of specialized training. At the same time, they provide opportunities for adapting some health jobs to the capacities of less-trained persons who can thereby make useful contributions to the needs of patient care in entirely new kinds of careers.

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[6] Mark S. Blumberg, "Special Care Units", *Modern Hospital*, January 1965.

## *Developing and Conserving the Health Manpower Supply*

According to many observers, shortages of health manpower have been chronic for 25 years or more. The dearth of trained personnel has been getting worse just when Medicare and other recently enacted programs have generated new demands for health workers. Perhaps efforts to deal with today's critical shortages, if followed through vigorously, will succeed, during the decade ahead, in bringing to an end the chronic shortage of qualified health personnel.

The various efforts needed to expand, develop, and conserve the supply of trained health personnel will demand cooperation from many different groups and agencies, from the national to the local level. Success in erasing manpower shortages is more likely to be achieved if general agreement can be reached on the need for giving priority to *immediate* problems and needs, specifically to achieve these urgent objectives: (1) To find and develop qualified personnel for assignment to existing health job vacancies; (2) to reduce turnover losses, minimizing the drain on trained personnel *now* employed in health care facilities. Long-range plans should be integrated with efforts to meet the needs of the present and near future, since planning well ahead will lack relevance if current shortages are permitted to get worse.

Immediate problems require stress on programs for full utilization of active and inactive persons already trained in health specialties, and on projects to train quickly people who can perform technical jobs now done by skilled and professional personnel. This emphasis implies no need for neglecting programs for expanding the training of new practitioners in those health professions that require lengthy training—the physician, nurse, and paramedical specialists who are the leaders and mainstays in the health manpower team. Nor should emphasis on immediate needs mean that programs for increasing skill, professional standards, and related requirements for health jobs would be neglected. A realistic balance between quantity and quality of health personnel has to be maintained. Efforts to set new and higher standards for health jobs should not exceed the pace at which personnel trained at higher standards are likely to become available, either by upgrade training of present workers or recruitment of new graduates.

The critical problem of health manpower shortages has been receiving increasing attention from leaders and specialists in the two broad fields involved—the health professions and the general field of manpower economics—during the past year. The efforts they urge tend to follow parallel lines. A few recent statements by these leaders may be quoted here. At the White House Conference on Health, held in Washington in November 1965, Dr. Lowell T. Coggeshall said, summarizing the discussion at the panel sessions on health professions' education, as follows:

> Education for the health professions and their coworkers at all levels must be reexamined and strengthened. New and continuing incentives to attract all people, including the underprivileged, to the health field must be developed. An outstanding example is the vast reservoir of unskilled persons from which to expand and improve the health manpower situation. A significant part of this reservoir involves the youth of low income families. This important national health resource has yet to be adequately tapped. Furthermore, many disadvantaged might achieve useful and productive employment in the health fields even though they may not be qualified for professional education. We must find a way to reach into all economic strata to augment the health manpower pool. . . . Experience and education can be transferable and provide for the development of new type of health professional. . . . Horizontal and vertical mobility will become more and more essential if we are to break down the

> artificial barriers which separate one segment of the health manpower pool from another. We must find positive means to encourage persons of ability to move up the career ladder as their talents permit.

The need for vertical mobility in health jobs was particularly stressed by Dr. William H. Stewart, Surgeon General of the United States, during his talk at the White House Conference:

> Artificial barriers separate one stratum of the health manpower pyramid from another, buttressed by such considerations as academic credits. Can we devise career ladders to permit the highly capable practical nurse to move into professional nursing, the professional nurse into medicine, the hygienist into dentistry? Wouldn't all the disciplines ultimately gain from such vertical mobility?

At the Conference on Job Development and Training for Workers in Health Services, held in Washington during February 1966 under the sponsorship of the U.S. Department of Labor and the U.S. Department of Health, Education, and Welfare, Prof. Eli Ginzberg of Columbia University, Chairman of the National Manpower Advisory Committee, commented along these lines about the relationship between training and other programs for dealing with problems of the health manpower supply:

> It is always an error to focus on increasing the supply without simultaneously considering the wage structure and utilization patterns. If the latter are awry then, no matter how many are recruited and trained, the supply will still be inadequate since dissatisfied workers will leave. The wage structures are still out of line with the market in many paramedical fields. . . . If wages and working conditions are made competitive, good training can help attract and retain the expanding numbers that will be required. . . . Adequate education and training opportunities must exist not only for persons entering the field, but also be built into the career process and be tied to promotional opportunities. . . . Unless steps are taken to facilitate upgrading of persons even across professional lines—i.e., nurses and physicians; professional nurses and practical nurses—much manpower will remain underutilized. . . . The unfreezing of many existing barriers in and among professional and semiprofessional groups cannot be left solely to them. It requires the participation of third parties—educational authorities, financial agencies (insurance), government.

The February 1966 Conference was attended by representatives of professions and vocations, institutions and organizations, both governmental and private, concerned with health manpower problems at all levels. At this meeting, many of the participants put particular emphasis on the need for better development and interchange of information with which to deal with health manpower questions. They stressed the need for more knowledge on such subjects as availability of financing, equipment and other material resources, consultant help, research results, and other tools for coping with problems of health manpower at National, State, and local levels.

Space does not permit more than brief consideration of the many different programs needed to expand and develop the manpower supply. The sections that follow sketch briefly some ideas concerning specific elements on which consensus appears to be developing in reference to the three areas of particular significance: (1) Training, (2) utilizing money incentives in health manpower development programs, (3) needs for improved information in health manpower.

## *Programs for Training Health Manpower*

Health manpower is being trained today in many different categories, in numerous types of courses, in a variety of facilities. Much of the training activity is a continuation of long-established programs. Some of it was begun more recently, by private groups as well as government units. The question that is being raised on all sides, as problems of health manpower needs continue to be urgent, is: What should be done that isn't being done or isn't done enough? Some steps described below reflect views expressed by many of the experts consulted during this study.

*Probably the quickest and most effective way of reducing the shortage of qualified nurses would be to bring back into active service a large proportion of the estimated half million inactive professional nurses, more than half of whom are women who have maintained their licenses.* To bring back these nurses requires great expansion of refresher training courses, in projects set up at convenient places and hours. If possible, arrangements should be made to provide also for their subsequent employment under attractive conditions (regarding wages, hours, and possibly care of their preschool children by nursery aides or trainees). Such programs have already been carried out successfully in many communities and individual hospitals. Refresher courses and related arrangements should not only be expanded in MDTA and other Federal Government sponsored projects, but should be set up under the auspices of local governments and private authorities. They should be given consideration in every community and facility that seriously feels the pinch of the nurse shortage.

*Career ladder training projects for health workers should be established on a wide scale, both within health facilities and in arrangements between those facilities and vocational schools, colleges, and professional schools, to facilitate upgrading of health workers.* The particular means provided, or arrangements to be developed, will obviously vary between such alternatives as helping a hospital orderly become qualified as a practical nurse, helping practical nurses to get the academic and other training needed to qualify for a professional license, or upgrading a laboratory assistant to a higher level position in the laboratory. Some of these objectives will be difficult to achieve, such as working out arrangements to help professional nurses toward becoming physicians, but there is no reason why even this should not be tried. Certainly, it should not be difficult to set up many career training projects that will help associate and diploma nurses (2- and 3-year graduates) toward baccalaureate degrees in nursing or in paramedical specialties by providing adequate recognition and credit for past education and experience (which is generally withheld at present).

The impetus toward establishing career ladder training projects should come from both government and private initiative. Such projects for health workers can help to do away with the widely held belief that hospital employement is a dead-end, blind alley choice for an untrained young worker. Opportunity for growth, not only in personal expression but also in income through such training, will help to conserve the health manpower supply by reducing labor turnover and increasing efficiency in health facilities. Moreover, the establishment of career ladder training systems will help to expand the supply of the scarcest groups of health personnel—those who require the longest training—more quickly than if the existing system of relying solely on training raw recruits is continued.

*Programs for recruiting and training new recruits to the health service industry, in both professional and nonprofessional jobs, should be expanded and utilized to the full.* This segment of the health manpower training system will always be a main source of needed additions to the health manpower supply. Many of the programs for expanding facilities for training health manpower, such as the MDTA programs, the Vocational Education Act of 1963, and the Nurse Training Act of 1964, are relatively new and in early stages of development. They need continuing support and active cooperation from institutions and professional groups at national and local community levels in order to fulfill their purposes. However, expansion of training facilities will have little effect unless more recruits enter the field of health service. The flow of recruits is not likely to be adequate unless health careers become more attractive—by offering improved pay levels, working conditions, and promotional opportunities, and unless scholarships are made more widely available, as discussed in subsequent sections.

*More experimental and demonstration projects are needed to develop and show new methods of training recruits for health jobs, as well as approaches for helping workers to get the training needed for upgrading.* New approaches to training should be supported, especially to develop paramedical specialists to handle tasks now being done by health professionals. Programs for training people for some of the new kinds of jobs that are emerging require experimentation to develop facilities, curriculum, and other resources and arrangements. An example of such efforts which is currently in progress is an experimental project to train as "assistant physicians" men who were formerly medics and corpsmen in the armed services. In this project, sponsored by the Duke University Medical Center, the intention is to produce subprofessional physicians' assistants (not to be confused with the secretarial "physicians' assistants" who work in doctors' offices) who can help with special techniques such as kidney dialysis, use of hyperbaric equipment, intensive care procedures. Similar experimental projects related to needs for people trained in a variety of specialties are being undertaken by various institutions and agencies, public and private, and will continue to be needed. Some projects are focused on the problem of how to train older persons, handicapped, and other disadvantaged individuals to fill increasing needs for home health aides. Other projects aim at improving methods of training surgical technicians. Experimental programs will be particularly useful in developing ways of helping experienced health workers to get the additional training they need to advance on the career ladder.

Demonstration programs will also be needed, to show and explain to schools and hospital managements the new successful approaches that are being developed for training people to do specialized health jobs.

### *Harnessing Money Incentives*

Patient care institutions have had to rely to a substantial extent on the personal dedication of health workers—their wish to be of service to those in need of help—in order to operate satisfactorily. This will always be true. But recent trends indicate that under current conditions of growth and change, incentives such as altruism, service ideals, and professional pride, while still important, are not enough to attract and retain the quantity and quality of personnel needed. It is coming to be widely understood that efficiency in utilizing staffs and facilities has suffered, and even that levels of patient care quality have in some instances fallen off, because of inadequate recognition of the power of money incentives in the job market.

Competing for workers with industries or vocations that offer higher pay and easier hours and working conditions (often in return for a smaller requirement of investment in training), the health field has been losing ground steadily. To redress the balance, deliberate harnessing of pecuniary incentives will be required. Such goals as increasing and stabilizing the work force in health service, improving efficiency, and perhaps even offsetting the rising costs of health care can be brought closer by putting money incentives to work.

*Scholarships and living allowance incentives should be made available to qualified candidates for training in critically scarce health occupations.* Under existing and pending legislation for aid to post high school training in the health professions, the only form of student aid available on a large scale is tuition loans that must be repaid (at least in part). It is widely believed that reliance principally on the loan approach is insufficient. Modifications to provide scholarships to substantial numbers of qualified applicants, at least covering the first year's tuition and living costs, and similar financial incentives, could result in much higher recruitment response without greatly increasing the costs of recruitment programs.

The income needed by students for maintenance during training should get major attention in programs for training subprofessional health personnel, whether under government or private sponsorship.

*Salary structures in hospitals and other health facilities should be shaped to attract and hold employees interested in career advancement.* Arrangements are needed to promote vertical and horizontal mobility for employees in hospitals and other health facilities and to set salary scales that promise advance in incomes to workers who grow in skill and responsibility. These arrangements should be geared to career training programs and other measures to improve the skills of employees.

*Salary levels of workers in health facilities, especially those in low-paid jobs, should be raised* *to parity with those paid in comparable employment in other fields by extension of provisions for Federal and State minimum wage and collective bargaining protections.* Without the stimulation of third-party influences, such as statutory requirements, it is difficult to raise salary levels of health workers significantly. In many communities, the influence of some local hospital governing bodies works toward general stagnation of hospital employees' pay. Under these conditions, managers of hospitals do not respond to conditions in the job market that call for raising wages with the same alacrity shown by managers of other kinds of establishments, with the result of ensuing losses of trained health workers through turnover.

The hourly minimum for hospital workers should be set at a rate no lower than that of other workers, in Federal or State minimum wage laws, if relief of health manpower shortages is recognized as a major goal.

*"Profitsharing" plans suggest a way of reducing operating costs and labor turnover in hospitals while raising employees' incomes.* The outlook for proposals relying on money incentives to increase the supply and quality of health manpower depends on an answer to the question, "Where will the money come from?" Costs of hospital care have jumped so high during recent years that it is understandable why governing boards show reluctance to increase costs further through either wage structure changes that encourage career development or general pay raises via minimum wage legislation or collective bargaining. There is little doubt that further substantial increases in labor costs would provoke financial crises in some hospitals, yet it seems inevitable that increases in the average pay of hospital workers will take place in most hospitals in the next few years.

It is perhaps of interest that at least one hospital has found a way of keeping operating costs down while providing increased income to employees, by use of an incentive plan akin to profit sharing. Memorial Hospital of Long Beach, Calif., a modern 400-bed voluntary hospital, adopted a "gain sharing" plan in 1961 through which it has been distributing to employees the savings in operating costs realized by economies in materials and man-hours. This is a group incentive plan, conducted in conjunction with a work simplification program designed to raise productivity. Savings from efficiency gains are shared with employees in the form of deferred payments (severance, retirement, and death benefits). The plan has not only helped lower the hospital's operating costs, but has also aided in reducing labor turnover.[7] Of course, other hospitals have been able to improve efficiency and keep operating costs down, but the fact that employees of Memorial Hospital share in efficiency gains gives them a stake in improved productivity. This principle has universal appeal and can make a significant contribution toward raising the standards of manpower utilization in the health service field if it spreads to other hospitals.

## Needs for Information and Research Programs

More attention is being given to the subject of health manpower today than ever before, but very much remains to be done. A frequently expressed need is an improved system for informing individuals, agencies, and groups about efforts that are being made to deal with health manpower problems in which they are interested. Another major need is to fill gaps in statistical and factual information on health manpower and related subjects through systematic research.

*Central, community-wide facilities and arrangements are needed in many areas to provide better information on the community's needs and resources for developing health manpower.* Much needs to be done to make available in all communities, to individuals, agencies, and groups concerned, information on health manpower problems and resources available to help solve them. In many communities there have been instances in which hospitals have not known that financial support, expert advice, or other resources were available to help them with manpower problems—from Federal, State, or local government units, or from private agencies.

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[7] Donald C. Carner, *A Program for Hospital Incentives* (Madison: University of Wisconsin, Center for the Study of Productivity Motivation, School of Commerce, 1965), and J. J. Jehring, *An Evaluation of the Merit Incentive Program at the Memorial Hospital of Long Beach* (Madison: University of Wisconsin, Center for the Study of Productivity Motivation, School of Commerce, April 1965).

Two forms of local information-spreading and coordinating machinery are needed:

1. Conferences and continuing bodies at which representation would include: Hospitals and other health service establishments that require and employ health manpower, and schools and other groups that help provide the supply, as well as professional and other groups concerned with the quality and quantity of manpower in various health callings, and other interested governmental and private agencies at Federal, State, and local levels.

2. A small central staff to provide continuing service such as: (*a*) Helping to maintain coordination among groups; (*b*) collecting and circulating information on new community activities related to health manpower; (*c*) assembling statistical information and estimates on current and future needs of health facilities for manpower, by occupation, and how it is to be balanced, currently and in the future, by either newly trained recruits or former workers who return to the health field (as shown by information supplied by training facilities licensure agencies, professional groups, etc.). Such information will be of vital importance toward balanced planning and development of health manpower on a community and State-wide basis.

*Research programs are needed to provide answers to many outstanding questions related to health manpower.* It is apparent that many different kinds of research effort are needed to deal adequately with the changing needs and opportunities that will continue to develop in the field of health manpower. These areas of need clearly stand out:

1. *Programs to fill gaps in statistics*—on the number of persons actually employed and the number of job vacancies in individual health occupations, among various types of health establishments; on the number and kinds of employees required in relation to existing and new methods and standards of health care, and in relation to differences in technological and other characteristics of health facilities; on the scope and description of training programs of all kinds, by which both recruits and experienced workers are learning either new or traditional health specialties; on characteristics of inactive former health workers; and on many other subjects related to the utilization, demand, and supply of health workers, in local particular communities, in the Nation as a whole, and in other parts of the world in which the United States has obligations. Data now available on some of these subjects is very incomplete or lacks the up-to-dateness or frequency of recurrent collection needed for guidance in planning health manpower programs.

2. *Research projects*—on many individual problems of health manpower needs and utilization, ranging from specialized subjects related to specific health occupations in particular localities to broader subjects affecting the economy as a whole. For example, it would be desirable to study in detail the manpower implications, in terms of number and kinds of health workers to train, of providing vast and comprehensive mass health examination and screening programs, based on new advances in health technology, or of developing a mass system of dialysis treatment for kidney disease sufferers, in the Nation or in particular communities. Another example of a subject that needs study is related to the needs and the training resources of Federal Government agencies involved in health problems, both at home and abroad, and how they affect general requirements and availability of health manpower. Still another example is the need for studies of opportunities for fuller utilization of untapped or underutilized human resources in the many occupations included in health service employment—opportunities for young persons of school age and older, retired persons, minorities, housewives, handicapped, and other groups who could serve in the health field.

In regard to research on health manpower problems, projects designed to experiment with developing new ways of meeting health manpower problems particularly deserve support. Out of such experiments will come many of the ideas and insights needed to provide answers to the questions that continue to arise in the changing field of health manpower.

Both the statistical and research programs and projects and the action programs for improving the machinery for spreading information on health manpower will require full participation of governmental and private groups from national to local levels. This need appears to be generally recognized. The Federal Government's awareness of the need to solve health manpower shortages was shown in the appointment by the President of a President's Committee on Health Manpower, and a National Advisory Commission on Health Manpower, on May 7, 1966. The Commission is to study the problem and submit recommendations within a year. Many similar groups are studying and developing plans to combat health manpower shortages in communities throughout the Nation.

# *Appendix A*

## *A. Definition of the "Health Service Industry"*

The "health service industry" is a term used to designate both public and private "establishments primarily engaged in furnishing medical, surgical, and other health services to persons." The quoted phrase is taken from the definition of Major Group 80 of the Standard Industrial Classification Code—Medical and Other Health Services; however, SIC 80 includes only privately owned establishments whereas establishments owned by Federal, State, and local government agencies are included in the health service industry in this report if they are primarily engaged in giving care or service to patients. Under the SIC structure, government-owned hospitals and nursing homes are classified outside of SIC 80.

Specifically, the components included in the health service industry and their SIC codes, are grouped as follows:

*Hospitals:*
  SIC 806 (privately owned—i.e., voluntary or proprietary).
  SIC 9180, 9280, 9380 (Federal-, State-, and local-owned, respectively).
*Nursing and Rest Homes:* SIC 8092, 9170, 9270, and 9370 (privately owned).
*Medical and Dental Laboratories:* SIC 807 (privately owned).
*Offices and Other Health Service Establishments:* SIC 801, 802, 803, 804, and 8099 (privately owned by groups or individuals, providing the services of physicians, dentists, chiropractors, optometrists, physical therapists, associations operating clinics, and related services).

It should be noted that the health service industry as here defined *does not include* the activities of offices, clinics, or laboratories operated by Federal, State, and local governments which provide various types of public health services—such as mental and other health centers, examination and other diagnostic services, sanitation services, regulatory and other programs of environmental hazard control. Some of these establishments provide services similar to those of establishments included in the definition of the health service industry, but since relatively little information is available on the number of employees engaged in such services, their activities are referred to only incidentally. Also excluded are activities by persons in health occupations if they are employed in industries that provide materials or services needed by the health service industry, such as drug manufacture or wholesale and retail trade, and persons who may be trained or engaged in an occupation related to health service but are not employed in health service establishments.

# *Appendix B*

## *B. Statistical Appendix*

### *1. Differences Among Estimates of Total Employment in Health-Related Activities*

Estimates of employment in health-related activities differ depending on definitions used. Table B–1 presents in columnar form the two principal definitional elements that account for differences among estimates of health-related employment: First, the employment status and basis for expressing the number; second, establishment coverage exclusions. The final column furnishes estimates of average employment in 1965 according to each of five definitions, beginning with the estimate of employment in SIC 80 as published by the Bureau of Labor Statistics.

All other estimates shown were derived in the course of the present study. They are presented as ranges between two figures, reflecting the need to allow for a margin of error at least as large as indicated by the range shown—because of lack of sufficient basic data, statistical errors, rounding, and other limitations affecting most estimates of employment in the health field.

### *2. Productivity and Manpower Projections for the Health Service Industry*

Until recently, relatively few studies have been made of productivity in the health service industry. Several alternative approaches to measuring productivity in patient care establishments are currently being investigated. They reflect different purposes of analysis and different concepts for expressing output and input. In analyzing and measuring productivity, the focus may range from a

Table B–1. DIFFERENCES AMONG ESTIMATES OF PAID EMPLOYMENT IN HEALTH-RELATED ACTIVITIES, 1965

| Industry title | Employment basis, as defined | Exclusions from employment as defined: Establishments such as | Estimate, as defined: (millions) |
|---|---|---|---|
| 1. "Medical and Other Health Services," SIC 80. | Payroll employees only, full and part time (excludes physicians, dentists, and other self-employed practitioners). | —Government hospitals, nursing homes.<br>—Government environmental and other public health protective units.<br>—Nongovernment establishments outside SIC 80. | [1] 2.1 |
| 2. "Health Service Industry". | a. Payroll employees only, expressed as estimated full-time equivalent (all full-time, plus half of part-time jobs). | —Government environmental and other public health protective units.<br>—Nongovernment establishments outside SIC 80. | [2] 2.5–2.8 |
| | b. Payroll employees only, full and part time (not expressed as full-time equivalent). | —Government environmental and other public health protective units.<br>—Nongovernment establishments outside SIC 80. | [2] 2.9–3.1 |
| | c. Both the payroll employees, full and part time (not expressed as full-time equivalents), and self-employed health practitioners. | —Government environmental and other public health protective units.<br>—Nongovernment establishments outside SIC 80. | [2] 3.3–3.5 |
| 3. "All health-related activities". | All persons (on payrolls or self-employed) engaged in health-related paid activities, in all industries, including manufacturing, trade, scientific, and government health-protective or patient care activities. | —None (with possible exception of borderline activities such as animal licensing and care, sewage disposal, etc.). | [2] 3.7–4.0 |

[1] Published by the Bureau of Labor Statistics.

[2] As estimated in the present study.

single narrow activity (such as testing blood samples, or serving meals to patients, etc.) to the broad area of a whole hospital department, or even more broadly to the aggregate of service provided by the entire health service industry. Aside from the scope of analysis, approaches vary depending on whether an intertemporal or interspatial comparison is the aim. Intertemporal analyses of productivity usually compare ratios of output per unit of input as trends over a period of years, whereas interspatial analyses compare productivity ratios between establishments, departments, or other organizations or locations at a given point in time.

In constructing productivity ratios for the health service industry, it is usual to express input in terms of human effort expended, quantified by figures for employees or man-hours (it would also be possible to quantify nonlabor inputs, if desired). The output side may be represented by either of two quite different concepts: (1) Services (activities) performed, or (2) results achieved. The services performed on activities basis refers to specific activities such as days of bed care provided, physician visits, outpatients treated, urinalyses completed, bed sheets laundered, etc. All of these quantities may be readily determined by counting completed units or by calculating their dollar values (adjusted for price change). The *results* basis is harder to quantify; it strives to express the achievement of the health service establishment (or the industry as a whole)—in curing illness, preventing it, or otherwise helping patients to attain specific health goals such as removing disfigurements, delivering healthy babies, etc. Both concepts are useful for specific purposes. The "results" basis would have particular relevance from the standpoint of analyzing effectiveness of efforts to improve the quality of medical care. Up to the present, however, data limitations have stood in the way of much progress in measuring the productivity of the industry from the standpoint of "results."

Efforts to measure output and productivity in health services in terms of "results" have recently been begun by Victor Fuchs and associates of the National Bureau of Economic Research. Other examples of work on the measurement of output related to this concept are cited in the *Report of the Commission on the Cost of Medical Care* of the American Medical Association (vol. I, pp. 119–136; vol. III, pp. 23–72).

Currently underway in the Department of Defense is a project for measuring productivity in hospitals operated by the Armed Forces on the basis of both the results and services performed (or activities) concepts. These efforts, by David Schenker and other staff members of the Department, aim at providing figures, per unit of labor input, on "sick days saved" (i.e., effective additional man-days produced) and on number of cases cured, for various disorders, as well as figures on number of laboratory examinations or other services performed in the patient care facilities of the Armed Forces.

Various other studies of output and productivity in medical services have been carried out using the "services performed" concept, as expressed in different ways. Among these have been studies which have measured output in terms of physicians' fees (deflated for price change). An example is *Price Behavior and Productivity in the Medical Market,* by Joseph W. Garbarino (Institute of Industrial Relations, University of California, Berkeley, 1960). This concept is also the basis for measuring productivity in programs now being conducted by the Hospital Administrative Service (HAS) of the American Medical Association and by the Commission for Administrative Services in Hospitals (CASH), as described in chapter 2. A similar program for measuring productivity has recently been begun in the hospitals of the Veterans Administration. Thus far, these programs for measuring productivity in hospitals have stressed interestablishment comparisons.

Measurements of the effects of technological improvements in improving the trend of productivity in the Nation's hospitals may ultimately become available from the data being collected in the HAS program of the American Hospital Association. Meanwhile, there is available from the regular annual statistical compilations of the AHA a series on employee/patient ratios in hospitals dating back to 1946. These ratios, which reflect the "services performed" concept, are useful for analyzing and projecting manpower requirements in the health service industry as a whole. They show the effect of technological and related factors affecting productivity together with changes in the quality of clinical and personal care provided in hospitals. The quality changes result from changes in the nature and composition of services provided and in the number and kinds of personnel used, as well as technological improvement. It does not seem possible to separate out their effects in using the ratios.

During the past decade, the employee/patient ratio in hospitals has risen sharply. It is generally believed that this is due primarily to changes in the quality of medical and personal care provided in hospitals, which require greater use of labor in treating hospital patients. Available data do not permit conclusions to be drawn on whether decline in efficiency among hospital employees has contributed to the increase in hospital employment at a faster rate than the rise in the average patient load in hospitals. Apart from the question of efficiency, the following have been some of the developments requiring increased payroll-labor input for patient care in hospitals during recent years: Increased use of nurse aides and orderlies, less use of nonpayroll employees such as student nurses and internes, greater use of technicians of many kinds. Among changes in quality of service have been these: Greater requirements for intensive care because of shorter average hospital stays and greater use by patients of private and semiprivate accommodations.

As indicated in the discussion that follows, in the present study an effort has been made to relate the assumptions stated in the text concerning expected future trends in the character of health services demanded and in future trends in productivity to available data and estimates on the employee/patient ratio in hospitals and nursing homes. The discussion below makes the assumptions in the text explicit in quantitative terms, as a basis for projecting total employment in hospitals and nursing homes to 1975.

Employee/patient ratios are available as the number of full-time equivalent employees per 100 patients (average daily patient census during the year)—for inpatients—as reported by the American Hospital Association. In accompanying table B–2, this ratio and its underlying figures on employment and number of patients are shown for 1955 and 1965 in line 1 for each year. Line 2 for each year shows estimated employee/patient ratios in hospitals after adjustments were made to take separate account of: (1) Employees actually working with inpatient cases, and (2) employees actually allocated to outpatients and home care, allowing for a large margin of error in this separation adjustment.

The projected employee/patient ratios for 1975 are based on these assumptions:

(1) That by the end of the period 1965–75 employee/patient ratios will have continued to grow at varying rates in each of the three types of patient care services shown (inpatient, outpatient-home care, and nursing homes). The varying rates reflect a probable greater increase in intensity of care among outpatients and home care cases than among inpatients, and also some offsetting productivity improvement in the case of hospital inpatient care;

(2) A substantial growth in the importance, and therefore the weighting effect, of the services other than inpatient care during the decade ahead.

The dominating influence is that of the shift toward the importance of patient care in outpatient clinics, home care services, and nursing homes (as compared with inpatient care) in the decade ahead. Rough estimates of the number of patients who will be cared for in all three services are shown. When

Table B–2. ILLUSTRATION OF EFFECTS OF SHIFT IN EMPLOYEE/PATIENT RATIOS, 1955–75

| Unit and type care | Employees per 100 patients (average day) | Number of patients (average day) (thousands) | Number of employees (full-time equivalent) (thousands) |
|---|---|---|---|
| **1955** | | | |
| Total: Hospitals, inpatient basis | 93 | 1, 363 | 1, 300 |
| Total: All patients (adjusted) | 71 | 2, 063 | 1, 480 |
| Hospitals, inpatients only | 89 | 1, 363 | 1, 225 |
| Hospitals, outpatients and home care | 25 | 300 | 75 |
| Nursing homes | 45 | 400 | 180 |
| **1965 (preliminary)** | | | |
| Total: Hospitals, inpatient basis | 134 | 1, 450 | 1, 950 |
| Total: All patients (adjusted) | 93 | 2, 350 | 2, 200 |
| Hospitals, inpatients only | 125 | 1, 450 | 1, 825 |
| Hospitals, outpatients and home care | 32 | 400 | 125 |
| Nursing homes | 50 | 500 | 250 |
| **1975** | | | |
| Total: Hospitals, inpatient basis | 150 | 1, 600 | 2, 400 |
| Total: All patients (adjusted) | 83 | 3, 600 | 3, 000 |
| Hospitals, inpatients only | 125 | 1, 600 | 2, 000 |
| Hospitals, outpatients and home care | 40 | 1, 000 | 400 |
| Nursing homes | 60 | 1, 000 | 600 |

these estimates are related to the expected employee/patient ratios for 1975, the results are figures shown for number of employees in table B–2.

The estimates of average numbers of patients who will be cared for daily in hospital outpatient and home care departments and in nursing homes in 1975 are based on sparse data and are likely to be somewhat wide of the mark. However, the important fact is that they will be *much* larger in 1975 than in 1965, a period during which the average number of hospital inpatients will have increased only *moderately*. The result will be a more moderate increase in total employment in health service because of the growth of these services outside of hospital wards and rooms, which are characterized by low labor intensity, than would occur if the demand for hospital inpatient services, which are characterized by high labor intensity, expanded equally rapidly.

It will be noted that the total full-time equivalent hospital employment for 1975 is thereby projected to 3 million. To this, an estimated 600,000 employees in practitioners' offices, laboratories, etc., for 1975 is added, to reach the total estimate of 3,600,000 employees in the health service industry in 1975.

## 3. Employment Estimates, 1965, and Projections, 1965–75

The estimates of employment in the health service industry in 1965 presented in text table 2 are based on a large number of sources showing total employment for the early 1960's in individual occupations and industries (hospitals, nursing homes, laboratories, practitioners). The main sources were:

(1) Annual data and special studies of hospital employment by the American Hospital Association;

(2) Estimates by the U.S. Public Health Service, based on Bureau of the Census figures and other sources (as extended, adjusted, and published in the *Health Manpower Source Book* series);

(3) *Occupational Outlook Handbook*, U.S. Department of Labor, Bureau of Labor Statistics;

(4) Various other published sources, cited in the footnotes and Selected References, and informed opinions by experts.

These estimates were checked, adjusted, and supplemented to fit control totals, to remove inconsistencies, and to account for establishments or occupations for which available information is sparse. For example, total employment in hospitals, estimated at 2 million in 1965, is based on the reported total of 1,952,000 in AHA-registered hospitals, adjusted upward by 48,000 as rounded off to account for over 1,000 other hospitals or similar facilities, most of which are known to be small.

All employment estimates and projections are stated as full-time equivalents—i.e., all full-time personnel plus one-half of all part-time personnel.

In preparing the projections of employment for 1965–75 for text table 8 (projected from text table 2 as a base), main reliance was placed on the assumptions regarding total demand for health services and expected shifts in its composition during the decade ahead, and on productivity expectations, as described briefly in the text, and in detail in the preceding appendix note. The employment projections developed on this basis were later checked by independent, simply extrapolated projections reflecting assumptions that the increased demand for manpower in short-term hospitals resulting from Medicare and related programs will not be paralleled by equivalent increases in Federal and other government hospitals, which are not likely to gain patients as a result of the Medicare program (in fact, they may lose some patients to voluntary and proprietary hospitals as a result of Medicare). In a third step, these overall projections were also checked for comparison by totaling independently the calculations of expected demands for major occupational groups. The original projections had to be modified only slightly on the basis of these three checks.

The projections of employment for the various occupational groups were made up individually, according to guidelines set by various benchmarks, studies, and opinions on projections of needs for each group (sources of which are mentioned in the selected references and in the lists of experts interviewed). The final figures were in some instances adjusted or smoothed as indicated by evidence such as data on expected expansion in demands for particular activities (lab tests, X-rays, etc.), estimates of the expected effects of laborsaving resulting from technological developments, and by further consultation with experts. As indicated earlier, the final projections of employment among occupational groups, when totaled, were found to be close to the total employment projected for 1975 as derived separately on the basis of assumptions tied to total employee/patient ratios.

It should be emphasized that all employment estimates are expressed in terms of full-time equivalent figures (full count of full-time employees, plus full-time equivalency for each two part-time workers). As such, these estimates differ from other estimates of employment stated in terms of the number of full- and part-time employees.

The rate of growth in total employment between 1965 and 1975 expected in these projections, covering the entire health service industry as defined here, differs from the rates of growth that would be indicated if the projections of employment had been expressed in terms of SIC 80 (Medical and Other Health Services). The latter definition excludes employment in Government hospitals and nursing homes, which is not likely to expand at the same rate as employment in nongovernment hospitals, mainly because of the uneven impact of the Medicare program.

It may be noted that the estimates of 1965–75 employment growth for the health service industry closely coincide with those stated for SIC 80 in the study by the U.S. Labor Department's Bureau of Labor Statistics published as *America's Industrial and Occupational Manpower Requirements, 1964–1975,* if allowances are made for: (1) Differences in number of years, (2) treatment of full- and part-time employment, and (3) industry definition.

# *Appendix C*

## *C. Appendix Tables*

Table C–1. TRENDS IN HEALTH AND MEDICAL CARE ECONOMICS, SELECTED YEARS, 1950–64

| Item | 1950 | 1955 | 1960 | 1964 |
|---|---|---|---|---|
| Total expenditures for health and medical care: percent of gross national product | 4.6 | 4.7 | 5.4 | 5.9 |
| Persons with hospital expense insurance protection: | | | | |
| Number (millions) | 77 | 108 | 132 | 151 |
| Percent of U.S. population | 49.1 | 65.2 | 73.3 | 79.2 |
| Indexes of consumer and medical care prices (1957–59=100): | | | | |
| Consumer prices—all items | 83.8 | 93.3 | 103.1 | 109.9 |
| Consumer prices, services, excluding rent | 75.4 | 90.8 | 106.1 | 117.0 |
| Total, medical care | 73.4 | 88.6 | 108.1 | 119.4 |
| Surgical fees—tonsillectomy | 81.5 | 92.7 | 107.9 | 118.7 |
| Dentists' fees | 81.5 | 93.1 | 104.7 | 114.0 |
| Optometric | 89.5 | 93.8 | 103.7 | 110.7 |
| Hospital room rates | 57.8 | 83.0 | 112.7 | 144.9 |
| Prescriptions and drugs | 86.6 | 92.7 | 102.3 | 98.4 |

SOURCE: Expenditures from Social Security Administration; price indexes from the Bureau of Labor Statistics: hospital insurance from Health Insurance Council and Health Insurance Association of America.

## Table C–2. TRENDS IN HOSPITAL TYPES, 1955–64

| Type of hospital | Hospitals: Number, 1964 | Hospitals: Percent distribution of number, 1964 | Hospitals: 1964, percent increase since 1955 | Hospital beds: Number, 1964 (thousands) | Hospital beds: Percent distribution of number, 1964 | Hospital beds: 1964, percent increase since 1955 |
|---|---|---|---|---|---|---|
| All hospitals | 7,127 | 100.0 | 2.5 | 1,696 | 100.0 | 5.7 |
| Federal | 441 | 6.2 | 1.0 | 175 | 10.3 | —4.4 |
| Non-Federal (type): | | | | | | |
| Short-term general and other special | 5,712 | 80.2 | 9.1 | 721 | 42.5 | 26.9 |
| Psychiatric | 487 | 6.8 | —10.1 | 691 | 40.7 | —2.3 |
| Tuberculosis | 187 | 2.6 | —46.1 | 40 | 2.4 | —42.9 |
| Long-term general and other special | 300 | 4.2 | —25.4 | 69 | 4.1 | —9.2 |

SOURCE: American Hospital Association.

## Table C–3. TRENDS IN HOSPITAL USE, 1955–64

| Type of hospital | Inpatient admissions, 1964: Number (Thousands) | Inpatient admissions, 1964: Percent distribution | Inpatient admissions, 1964: Percent increase since 1955 | Average daily patient census: Number 1964 (thousands) | Average daily patient census: Percent distribution 1964 | Average daily patient census: Percent increase since 1965 | No. of outpatient visits, 1964: Number (thousands) | No. of outpatient visits, 1964: Percent distribution | No. of outpatient visits, 1964: Percent increase since 1955 |
|---|---|---|---|---|---|---|---|---|---|
| All hospitals | 28,266 | 100.0 | 34.1 | 1,421 | 100.0 | 4.3 | 125,123 | 100.0 | 78.6 |
| Federal | 1,619 | 5.7 | 5.7 | 152 | 10.7 | −3.2 | 30,620 | 24.5 | 67.7 |
| Non-Federal: | | | | | | | | | |
| Short-term general and other special | 25,987 | 91.9 | 36.1 | 550 | 38.7 | 35.1 | 91,430 | 73.1 | 70.6 |
| Psychiatric | 442 | 1.6 | 41.7 | 632 | 44.4 | −6.6 | 1,120 | .9 | 146.2 |
| Tuberculosis | 62 | .2 | −28.7 | 28 | 2.0 | −50.0 | 680 | .5 | −43.2 |
| Long-term general and other special | 156 | .6 | −.6 | 59 | 4.2 | −9.2 | 1,273 | 1.0 | 15.3 |

SOURCE: American Hospital Association.

## Table C–4. TRENDS IN HOSPITAL EMPLOYMENT, PAYROLLS, AND PATIENT RATIOS, 1955 AND 1964

| Type of hospital | 1964 employment (full-time equivalent) | | | 1964 payroll | Proportion, payroll to total expense | | Employee/patient ratio[1] | |
|---|---|---|---|---|---|---|---|---|
| | Number (thousands, 1964) | Percent distribution, 1964 | Percent increase since 1955 | Million dollars, 1964 | Percent, 1964 | Percent, 1955 | 1964 | 1955 |
| All hospitals | 1, 887 | 100. 0 | 61. 4 | 7, 975 | 66. 3 | 64. 0 | 1. 33 | 0. 95 |
| Federal | 193 | 10. 2 | . 5 | 1, 238 | 82. 4 | 79. 6 | 1. 28 | 1. 22 |
| Non-Federal: | | | | | | | | |
| Short-term general and other special | 1, 333 | 70. 6 | 61. 4 | 5, 152 | 61. 7 | 61. 6 | 2. 42 | 2. 03 |
| Psychiatric | 264 | 14. 0 | 40. 4 | 1, 189 | 73. 9 | 58. 2 | . 42 | . 28 |
| Tuberculosis | 30 | 1. 6 | —37. 5 | 112 | 68. 7 | 63. 9 | 1. 05 | . 85 |
| Long-term general and other special | 67 | 3. 6 | 42. 6 | 284 | 69. 8 | 66. 7 | 1. 13 | . 71 |

[1] Number of employees divided by average daily patient census.

SOURCE: American Hospital Association.

## Table C–5. PROJECTED NUMBER OF HOSPITALS, NURSING HOMES, AND BEDS, 1965, 1970, AND 1975

| Type of hospital | 1965 | | 1970 | | 1975 | |
|---|---|---|---|---|---|---|
| | Hospitals and nursing homes | Beds | Hospitals and nursing Homes | Beds | Hospitals and nursing homes | Beds |
| All hospitals and nursing homes | 21, 123 | 2, 203, 000 | 27, 350 | 2, 700, 000 | 32, 500 | 3, 100, 000 |
| All hospitals | 7, 123 | 1, 703, 000 | 7, 350 | 1, 800, 000 | 7, 500 | 1, 900, 000 |
| Federal | 443 | 174, 000 | 400 | 180, 000 | 400 | 200, 000 |
| Non-Federal short term | 5, 736 | 741, 000 | 6, 000 | 820, 000 | 6, 200 | 900, 000 |
| Non-Federal psychiatric | 483 | 685, 000 | 500 | 700, 000 | 500 | 700, 000 |
| Non-Federal tuberculosis | 178 | 37, 000 | 150 | 30, 000 | 100 | 20, 000 |
| Non-Federal long term | 283 | 66, 000 | 300 | 70, 000 | 300 | 80, 000 |
| Nursing homes | 14, 000 | 500, 000 | 20, 000 | 900, 000 | 25, 000 | 1, 200, 000 |

SOURCE: See Statistical Appendix.

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# Appendix E

## E. Interviews

### Consultants

*Gordon A. Friesen Associates:* Gordon A. Friesen, Walter Spilman.

*Stanford Research Institute:* Dr. Mark Blumberg.

*System Development Corporation:* Harold Wilson.

### Government Agencies

*California State Department of Employment:* G. S. Roche, Mrs. A. Covington.

*U.S. Public Health Service*—

Division of Hospital and Medical Facilities: Philip Burgoon, Robert Fitzsimmons, Miss Helen Hollingsworth, Mrs. Marie Lech, R.N., John Reece, Dr. A. E. Rikli, Mrs. Mary Sims, Miss Josephine Strachan, R.N.

Division of Nursing: Dr. Eugene Levine, Stanley Siegel.

Division of Public Health Methods: Dr. Richard A. Prindle, Mrs. Margaret D. West, Dr. Clem C. Linnenberg.

National Center for Health Statistics: Sidney Binder, Theodore D. Woolsey, Mrs. Maryland Y. Pennell.

Office of Surgeon General: Mrs. Lucile Petry Leone, R.N.

## *Hospital Administrative and Medical Staffs*

*Carroll County General Hospital* (Westminister, Md.): Joseph R. McFerron, Mrs. Janice Lovell.

*Children's Hospital* (Akron, Ohio): Charles M. Campbell.

*Georgetown Hospital* (Washington, D.C.): Dr. Ann Peterson.

*Holy Cross Hospital* (San Fernando, Calif.): Sister Mary.

*Holy Cross Hospital* (Silver Spring, Md.): Sister Justine Marie.

*Kaiser Foundation Hospital* (Oakland, Calif.): D. Ernst.

*Montefiore Hospital* (Bronx, N.Y.): Fred Silverman.

*Veterans Administration* (Washington, D.C.): Dr. L. G. Christianson.

## *Professional Groups*

*American Hospital Association:* Dr. James B. Hartgering, Colin Churchill, Theodore Gregory, Edward W. Weimer.

*American Medical Association:* Herman Gruber, Henry R. Mason, Dr. Grant Osborn, Christ N. Theodore.

*American Nurses' Association:* Miss Meryle V. Hutchison, R.N., Dr. Wanda E. McDowell, Miss Julia C. Thompson, R.N.

*National Association for Practical Nurse Education and Service:* Mrs. Veronica Conley, R.N.

*National Committee for Careers in Medical Technology:* Mrs. Dallas Johnson.

*National League for Nursing:* Dr. Barbara Tate, Miss Evelyn Zetter, R.N.

## *Supplier Firms*

*American Hospital Supply Corp.:* William K. Henning.

*International Business Machines Corp.:* G. Kramer, F. W. Boegel.

*Lockheed Missiles & Space Co.:* H. H. Mathews, A. E. Sibley.

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